Pit and Quarry

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Pit and Quarry Hand Book (1928 Edition) Ready

Copies of the 1928 edition of the Pit and Quarry Hand Book have been mailed. This latest edition is thoroughly revised and enlarged. It represents the combined work of many specialists and has been prepared to serve in solving the daily problems arising in the field. Every owner of this book will find it a valuable operating manual.

THE CONSTRUCTION SITUATION

By A. E. Dickenson

A YEAR ago at this time warnings of a severe slump in building were quite numerous. Danger signals were solemnly pointed out. Some observers declared a slowing up was inevitable.

These gloomy forecasts were for the most part predicated upon the fact that building activity had been very heavy for a considerable period. They ignored certain fundamental conditions, one being that a deplorable shortage existed before broad-scale activity was resumed. Another was the immense population growth of the country and the consequent industrial and commercial expansion involved.

When we predicted a year ago that the value of new building during 1927 would perhaps equal that of the preceding year the estimate was regarded as somewhat optimistic. Yet the total is but slightly under that of last year.

Despite three years of a six to seven billion dollar construction expenditure there is nothing to indicate that next year's total will fall below those figures. On the contrary it is becoming more and more apparent that building has been stabilized on a plane consistent with the growth of the nation, that the vicious peaks and valleys have been ironed out, and that speculation has been in a large measure eliminated. Sound conditions and genuine confidence in the future mean a continued large volume of new building.

While there may be temporary reactions, it seems likely that building may reach records as high or higher next year than were established this year. One outstanding reason is the large volume of new bond issues floated in the past few months. These issues will provide huge sums for new construction in 1928.

It is futile to try to predict the course of the building industry by comparisons with years that preceded the period of larger programs. Besides the annual population increase of over 2,225,000 persons, necessitating some 520,000 new homes each year, there is the persistent demand for larger and more modern structures. The whole country is living on a different plane. There has been a transition in the building industry to meet these new conditions. Expenditures for theaters, public buildings, churches and skyscrapers, some large enough to house a small town, bring the yearly totals up to sums that dwarf totals in years preceding and following the war.

In a word, what once seemed to be normal building expenditures can no longer be regarded as normal in a nation whose commercial and industrial expansion is unequalled in history.

Of the total building expenditure of the past year, residential construction accounted for about 43 per cent. This is slightly under the total of the previous year. But there is a continued demand for new homes. A still stronger demand exists for public works. In almost every city of importance this class of building is needed to supplement present facilities. Warehouse space of many types is likewise in demand. Educational buildings are badly needed. Public building programs in many districts have been held in abeyance awaiting a temporary reaction. Winter building, which has greatly aided in stabilizing the entire industry, promises to equal last winter's record.

In the quarries and mills of the Indiana Limestone Company plans are being made for a record business in 1928. The company now has a production capacity of from fourteen to sixteen million cubic feet of stone a year.

1928—AND BEYOND

By R. B. Williams

JUST a few days ago a faculty member of a great Chicago university made a statement that should pause every producer in the pit and quarry industries on this continent. He said: "Only a scant 10 per cent of all university students ever attain the position of financial independence at the age of 60 years."

And that statement was made out of the fullness of definite knowledge and complete facts since the professor has been teaching for 32 years; and has exhaustive and comprehensive records covering every student with whom he has been associated. His records, or "histories" as he is wont to call them, give the student's name, address, age at entry, personal inclination, who pays for the schooling, grades received in academic work, when schooling was discontinued, kind of work assumed upon leaving school, personal and commercial progress, starting salary, and approximate present income. The very existence of such histories, numbering into the thousands, indicates authenticity.

That broad indicting statement should interest members of our industry if only because it so closely parallels the oft repeated statement of the National Industrial Conference Board that less than 50 per cent of all manufacturers ever make one cent of profit, while not more than 10 per cent of them know what are their production costs.

Why should this be true? Why should our enormous student body, provided with the finest training possible to secure, show up as being only 10 per cent successful—the word "success" being used in the common, financial sense? Why should less than half of our 300,000 manufacturers continue a profitless business?

Again the professor speaks in answer and it may be he has answered both questions.

"Because our students (manufacturers—?) lack vision; or, having it, fail to exercise it."

Certainly the student or industrialist who lacks vision will fail. There isn't the slightest doubt about it. Regardless of who he may be or where located, how many fraternity pins or gravel pits, athletic letters or washing plants, degree insignia or capital assets are his, if he hasn't vision, and the intestinal fortitude to exercise that vision, he will fail, at any event in the commercial sense. The reason lies in the tremendous rapidity with which we are progressing and will continue to progress.

Time was when a university training was the open sesame to commercial success. That was in the day when workmen's wages were paid semi-annually, the factory system of production was yet undeveloped, domestic requirements were few and semi-illiteracy common. Those conditions no longer exist. Hence the need for the best possible training, vision, and its exertion.

Time was when mass production and the installation of material handling machinery was the key to success for the manufacturer. That was when a dollar was at par, dealer's and jobber's stocks were large, installment selling was little or unknown, and efficiency experts were drawing high salaries. Today, this condition is changed. Scientific research has a definite place in every development. Competition is no longer limited to coworkers in a single industry, and radical, far-reaching changes are everyday occurrences. Science and engineering have assumed command. Hence the need for vision—and its exertion.

Just last summer the writer motor-toured through the East. Leaving Chicago, we went as far south as the Blue Ridge Mountains, as far east as Boston, crossed the St. Lawrence River at the Thousand Islands and returned through Ontario and Michigan. We traveled 3,300 miles, and less than 50 miles of our highway was unpaved. Nearly 98.5 per cent of our trip was made over smooth concrete; and calmly and unhurriedly, we averaged 265 miles a day.

What cynical laughter would have been caused by the statement, had it been made just 30 years ago, that the three or four mechanics who were toying with little benzine buggies would not only develop one of the greatest industries in all history, but bring along by sheer force the subsequent development of the cement industry, road machinery and crushed rock business, and many others; at the same time cause the demise or serious disruption of no less than six theretofore great industries. And just 30 years ago.

Thirty years from today our highways will be four times as wide; rebuilt to withstand several times the weight they can now endure; flood-lighted at night to permit 24-hour travel; boulevarded to enforce segregation of vehicles in accordance with their speed; and grade crossings will be a thing of the past. What the benzine buggy mechanics started for the cement and road building machinery folks, 30 years ago, will be extended to the structural steel, electric light and power, and other industries in the early tomorrow.

While in Worcester, Massachusetts, I talked with a stooped, white-haired nonagenarian who told me when he started to work, every concern in his community paid men's wages semi-annually. His weekly wage was $3.50 and his hours of work were from "sunrise to sunset." Today, wage earners enjoy eight-hour days, produce from four to six times as much, and earn nine times the wage. And all in the span of one lifetime.

Edison has done more than any other one man to develop electricity. Today that form of energy is making hens lay six to eight eggs a day (by means of the ultra-violet ray); powering ultra-audible microphones that will pick up insect voices (thus opening a whole world of sound to scientific and practical research); transmitting the world's news at the rate of 186,000 miles a second (radio); lengthening the span of human life from 37 to 58 years; digging tunnels under mountains and rivers, measuring the intensity of star light, and removing tonsils painlessly. And all in the span of one lifetime.

When John D. Rockefeller was born (and he is still living) we had no such things as ether, galvanized wire, babbitt metal, trip hammers, steam shovels, acetylene gas, linotype machines, cylinder presses, typewriter, x-ray, manufactured gas, airplanes, the Suez Canal, telephones, adding machines, motion pictures, punch presses, motor boats, incandescent lamps, automobiles, nickel steel, repeating rifles, roller flour mills, time clocks, or any other of a thousand different things that today are absolute necessities.

What a profound change has taken place in the methods and appliances used during the past 50 years! Ponderous creatures of steel have been made substitutes for muscle, they working side by side with instruments so delicate as to be rendered inoperative by the glow of a man's face or hand. In the iron range of Minnesota electric shovels handle 90 tons of ore at a single dipperful, while in the laboratories of the General Electric Company is an instrument that will measure atoms one billionth of an inch in size—or things so small as to require one million of them placed end to end to equal the thickness of a flea's wing. Never before have any people been enabled to perform such tasks as are now accomplished in the United States. One of the reasons is we have developed more than 12 mechanical horsepower for every member of our population. Considering only the hydro-electric power we have thus far harnessed, we have from this source an amount of energy that exceeds the combined strength of all the people living in England.

Nor do our recently developed machines and appliances stop when they have met the requirement for which they were designed. Rather, each machine creates needs unto itself, or opens up channels for further expansion, development and refinement. Hence there is constantly present the element of surprise—and this is an element that is an ever-present threat for every phase of industry. As an instance, what will happen to the battery business, now that there has been perfected inexpensive units that will power a radio direct from the electric light socket? It is easy to see millions of dollars worth of business coming to the public utility companies from this source—that formerly went to the dry battery manufacturers.

Any attempt to look into the future reveals almost fearsome developments. That present tendencies will continue is taken for granted, if only because nearly every development opens the way for others, farther-reaching. Radio is just one of the developments that lies immediately ahead, with easily discernible effects. It must be apparent to every thoughtful individual that radio will become an increasingly important factor in our everyday lives. The perfection of the already developed beam radio, which permits the broadcasting of messages in a single direction, means the employment of radio by commercial institutions for price quotations, sales direction, and business management. Already radio has been used as a guiding influence for motor boats and automobiles. This means that presently great freight trains and large fleets of motor trucks and airplanes will be traveling across the country with no more than a single man in charge. Even right now the Chicago and Northwestern Railway is cutting down their signal towers and semaphores (along their main line from Chicago to Omaha) and substituting radio and electric control. Not far distant is the development of successful and economical broadcasting of both light and power. When this development reaches perfection, which it will, almost over night, it is a question of just what will happen to our enormous wire mills.

The broadcasting of pictures by radio is a development of the early tomorrow and this will doubtless mean a complete hook-up and positive correlation of every public school in the United States. One great educational system will supplant our old, inefficient, and widely differing, multiple systems of today. In our travels by motor, plane or rail, the radio-telephone, equipped with beam control, will keep us in constant touch with the office. This will make the matter of personal absence from business by executives a matter of small concern.

Just around the corner lies the completion of the Gulf to St. Lawrence waterway, which will have a profound effect on every industry. Such a development will completely alter the financial, commercial and social map of the entire United States—much to the discomfort of those now centered about the mouth of the Hudson River—but not so much as some fear since transportation facilities will be perfected to still further shorten distance and cut carrying costs.

Within the next 50 years one or two of our cities will have a population of 25 or 30 millions. And it is impossible to visualize a city with a population of 25 million people without foreseeing infinite changes in our present day mode of transportation, housing and feeding. Moving stairways and sidewalks will become commonplace; sanitary boards will demand the installation of mechanical refrigeration; milk will be transported in great pipe lines from the dairy regions, the standardiza-

tion of fruits and vegetables, with food in concentrated form will have progressed far toward perfection, and air transportation in taxi form will have become a positive necessity.

Such statements may seem chimerical. If so, then it is only because we would rather cling to things known than to exercise our vision. It is characteristic of human nature to falter in the acceptance of anything that will disrupt the even tenor of our ways. But that characteristic is becoming ever more dangerous. The present day rapidity of development makes it imperative that this be changed.

Illustrative of this characteristic is the old story of the colored gentleman who was so very much in love with his Eliza. It had been a case of love at first sight, and Cupid, it seems, had wielded a wicked blow. It had left them both nearly speechless. One night these two folks were sitting out under the stars, and our hero, after an impressive silence said: "Eliza—does you know whut I wishes ah wus?" "No, Tom," answered the dusky peach, "Ah doesn't have an incalculable idea. Whut does you wishes you wus?" "Well," quoth Tom, "Ah wishes I wus one of dem dar octupusses. You know—the kind whu has ten long arms." "For the lan's sake man, whut does you want to be one of dem octupusses for?" "Whut would you do wif ten long arms?" "Liza, ah wants them long arms so I can hug and squeeze you wif 'em." "Go long, man. You hain't usin' the two you got."

It is becoming increasingly necessary that we use our own two arms. We move rapidly now-a-days, with the result that we must keep abreast of the times if we are to stay in the race at all. It required 110 years to develop the steam locomotive but only 20 years to develop the automobile. It took 80 years to develop the telephone, but only four years for the radio. During 1925 only 362 airplanes were sold to private companies or concerns. Last year, that class of sale topped 20,000. During the coming five years the aircraft industry will go as far as the automotive industry did in its first decade.

If we are to look backward with pride we must look ahead with vision. If we are to increase the percentage of successes among either university students or manufacturers, we must exercise that vision. Science and engineering have assumed control. Let us never lose sight of that fact.

Standardization

By A. S. Deringer

Much is being said of late about the standardization of various products. This notion has become so contagious that even some lime producers have become afflicted with it and want to make it applicable to their industry.

It seems this notion is prompted by purely selfish motives, on the part of those producers, who realize they have a superior product, with the intention of eliminating the producer who is not able to compete with a high grade product. Only location and other natural advantages make it possible for them to be recognized as real competitors.

Every lime producer is aware that not all lime producing localities are favored alike by nature. That to produce a high calcium lime, they must have a source of supply that will analyze high in calcium carbonates. That to produce a high magnesia lime the raw material must contain a high content of magnesium carbonate. That if Nature has failed to provide either, in sufficient quantities, to produce a recognized standard it is impossible to meet the specifications of a so-called standard, except by means that will be economically prohibitive, and at a loss of the products' identity.

Standardization as applied to some products, especially cement, is a product of a vastly different problem. Since cement is a product composed of right proportions of various materials to produce a result that has come to be recognized as a standard. It is a question if there are over half a dozen cement producing plants that operate under identically the same conditions, with identically the same quality and quantity of raw materials. Since we assume this to be a fact it is necessary therefore for each individual plant to operate under a different formula in order to produce a standard product. Needless to say, lime producers realize this is impossible in the manufacture of lime.

Were a producer of lime that was neither recognized as high calcium or high magnesium to attempt to make a standard brand of one or the other, it would be necessary for him to mix his lime with either of the two recognized standards in such quantities that his product would lose its identity, and the price he could hope to command for such a mixture if it could be termed a standard product would make it impossible for him to continue in business.

Some lime plants in certain sections of the country are resorting to artificial means in order to make a product to successfully compete with the Ohio finish limes. While this may prove successful and profitable at great distances from the Ohio region and in direct competition with the Ohio limes, it is questionable if it will be as profitable should the two compete on an equal freight basis.

Since it depends entirely upon the raw material from which lime is produced, and since there is a great variation in the raw material in the lime producing centers, it seems to be impossible to arrive at a standard, unless the lime produced in some sections be recognized as a standard. This, then would work an injustice upon all the other producers who were denied the natural advantages enjoyed by the section so favored.

MEN OF THE INDUSTRY

The portraits printed on this page in each number of PIT and QUARRY are taken from our files and their selection is without significance as to current events or as to the position of the individual in the industry.

R. B. Henderson

Mr. Henderson is President and General Manager of the Pacific Portland Cement Company Consolidated.

WHAT A FLOOD MAY MEAN TO A STONE PLANT

By F. A. Westbrook

THE first thought that might naturally come to mind in considering the effect of the recent floods in Vermont is that where quarries were concerned they would be filled with water and therefore have to stop operations. As a matter of fact that was the least of the troubles experienced by the Vermont Marble Co. Some few of the company's many quarries were filled to be sure, but the largest and most important ones at West Rutland and elsewhere suffered no particular damage or curtailment from this cause. Actually the real problem which had to be faced was an electrical one and in fact throughout the flooded regions the wetting of electrical apparatus caused much more trouble than anything else, except, of course, where definite wreckage occurred.

A Former Road Became Overnight A Chasm With a Raging Torrent

The operations of the Vermont Marble Co. were largely suspended on account of the flooding of the two principal electrical generating stations owned by the company at Proctor and Baldens. To make the situation clear it should be said that the company owns and operates several water power sites on the Otter Creek. These are all tied together with a high voltage transmission line from which power is tapped off at the various plants. When therefore the two stations carrying 80% of the load were flooded there was ob-

The Railroad Embankment In Proctor Washed Out Leaving Tracks Suspended in the Air

Site of Transformer Washed Away by the Flood

The Railroad Station After the Flood

viously not enough power available to do much with. In addition to this many of the motors and conduit lines in the mills had a good soaking so that before operations could be resumed it was necessary to look after these items.

The situation at Proctor was the most complicated and will be the more interesting to describe. At this point there is a fall in the Otter Creek and a dam has been built on top of the falls. The river is rather narrow at the falls but widens out above the dam. As the water rose it overflowed low land above the dam. This would not have resulted in any great damage had it not been that a high ridge of rock which would otherwise have confined the water, had been pierced by a railroad cut. Through this the tracks approach the Procter station and pass through the Marble Company's property with the mills on each side.

What happened is not hard to guess. The flood waters rose to an entirely unprecedented height during the night, flowed through the railroad cut with great force, spread through the mill buildings and in part found their way back to the river bed below the falls by flowing down the steep bank at the top of which the mills are located. Unfortunately the power house is at the bottom of this bank. Consequently the water which had been by-passed around the falls and which flowed down the bank washed the latter clean of earth, cobbles and rubbish and deposited the whole mixture in the interior of the power house in the most indescribable mess. Thus the damage was not caused by excessive water coming over the dam but by that which passed around it. As the night wore on and the water began to encircle the power house from all sides the attendants decided that before long they would be marooned and that as the terrific downpour of rain showed no signs of abatement they had best leave while they could. Before doing so they shut down all the machinery, which was fortunate for otherwise it would have been ruined. If they had delayed their departure for another half hour they would have had to climb up to the traveling crane and spend a couple of uncomfortable days in isolation and probably without food.

The illustrations show better than words what the power house actually looked like when the waters subsided. Yet in the incredibly short space of three weeks the rubbish had all been cleared away, the electrical apparatus dried out and the generators were again running at full load. It is an interesting fact that the marble switchboard came through this unusual and trying treatment

Automobiles Were Left Half Buried in Sand

in excellent condition. It not only was not damaged mechanically by the stones heaped against it by the force of the flood waters, but it was restored to good condition electrically by the simple process of drying it out.

Note the Washed Out Roadbed and Upset Cars

Slope Above Power House Washed Clear of All Loose Material

While this was being done a good part of the Proctor shops and mills and the town of Proctor itself, were served by a temporary outdoor sub-station. It is a significant fact of much importance that the transmission line connecting the various generating stations and plant was not harmed by the high water so that some power could be delivered over them to Proctor from the generators still in operation and from the connections with the public utility system. A motor-driven Ingersoll-Rand compressor unit which is used in different locations for various special purposes was installed near the temporary sub-station to supply compressed air for work on some rush orders.

A temporary motor generator (General Electric) set was installed in one of the mills to operate the cranes and careful tests were made of all motors not in elevated positions with a megger so as to be sure that the insulation was high enough to obviate danger of burn outs. A great deal of damage was avoided in this way. The company's new electrical repair shop has had a busy time and it was fortunate that such a good one was available.

To show what force the flood waters had it is interesting to observe the damage done immediately north of the Marble Company's plant where there is another railroad cut, and through which the water flowed which did go down into the power house as already described. This water came through the cut and flowed off down a steep slope on which there was a road and houses on the lower side. The soil was rather gravelly and was completely washed away down to the bed rock some 100 feet below the former surface. All traces of the road and several houses absolutely disappeared. Several automobiles at the bottom of the slope were partially buried in gravel but the wreckage of the houses disappeared, washed down the valley and mixed with other debris. This all happened in the night with very little warning. Some of the occupants of the houses escaping in their night clothes with the narrow margin of ten minutes in some cases.

The engineer and fireman of a freight train locomotive which was stalled near the Proctor railroad station had to climb on the roof of the cab and spend a good part of the night exposed to the cold downpour. Although they suffered no permanent injury they had to be taken to the hospital to get over the effects of their severe exposure. An effort was made earlier in the night to reach them by two men on a raft but they were washed against a tree which they managed to climb into and where they, too, spent a miserable night in the rain until rescued by the same boat which finally rescued the engineer and fireman. Altogether there were a good many thrills experienced around the marble plant.

This Was a Highway Before the Flood

Interior of the Proctor Power House After Flood

Many of the Marble Company's buildings and sheds had their foundations more or less undermined by the flood waters, but although a good deal of labor and expense is involved in reconditioning these the operations within them were not very badly interferred with. The large quantities of various sizes of stock stored in the yards did not suffer in any way from their submersion. Perhaps the most interesting thing about the whole trying experience, and one which must be a great satisfaction to the company, is the manner in which all hands turned to repair the damage, and the fact that things were running practically up to normal within three weeks after the disaster speaks louder than words.

The Strength Specification Contract

By Robert E. Johnson

In July, 1926, representatives of five construction companies were called into the office of the owner of a proposed factory construction and shown a set of plans covering two kiln foundations, 400 feet long by 50 feet wide. Plans required 10,000 cubic yards of excavation and 6000 cubic yards of concrete divided between 1:2:4, 1:3:5 and slag. Bid forms were given to the contractors and they were requested to fill in unit prices for labor opposite the estimated quantities shown on the form, with the explanation that the owner furnish all material excepting lumber and nails for the forms. The Immel Construction Company was 50 per cent low and was immediately accepted and it submitted bids for the two buildings, one 940 by 200 feet, one story high and the other 340 by 80 feet five stories high, contemplated in the program and was accepted.

The construction company bid and secured the contract for all materials and labor entering into the plant which made a total of 95 separate figures not including the prices for materials f.o.b. on cars. Checking materials was simplified by using Taylor and Thompson's table of quantities based on 45 per cent voids.

Prices per yard of concrete in place having been decided, the construction company explained to the owner that it was losing 40 cents per yard of concrete on the materials and asked that the specifications be changed from a 1:2:3 mix which was too rich for a 2000 pound concrete to a 1:2:4 mix which was accepted and the construction company proposed that it be permitted to use any mix that would produce a 2000 pound concrete for the 1:2:4 mix or a 1500 pound concrete for the 1:3:5 mix which was accepted with the construction company being penalized for the saving in material on any yardage that would test below 2000 or 1500 pounds.

The various factors affecting the strength of the concrete at 28 days considered and controlled were, the quantity of cement checked by weighing; quantity of water checked by automatic tank, and slump test; no rigid control of mixing time; heating before and after mixing; and the test methods were not carefully checked at the beginning but were corrected later. A man was placed in absolute control of the proportioning material and a material clerk was in charge of the delivery, checking the quantities used and figuring the units completed.

Various tests were obtained, due to the different methods of handling both to and from the mixers. The one bag mixer was controlled only by slump tests which varied from 1½ to 3 inches with strengths from two samples at 1600 pounds to two samples at 3400 pounds and 24 samples between 2200 and 3100 pounds. The moving two-bag mixer with only weighing and slump control gave strengths of one sample 1300 to one sample 2400 pounds, with 17 samples from 1400 to 2300 pounds. The largest volume passed through the stationary two bag mixer where slumps varied from 4½ to 9 inches and 90 per cent of all the samples were above 1900 pounds, 80 per cent of all samples were above 2000 pounds, 50 per cent of all samples were above 2500 pounds and 30 per cent of all samples were above 2500 pounds. The average of the 76 samples was 2280 pounds and only 7 of the 76 samples fell below 90 per cent of the designed strength. These results may be compared with the Portland Cement Association Building on which 13 out of 34 samples fell below 90 per cent of the designated strength.

The actual savings made by having a Strength Specification Contract is approximately one bag of cement, 10 cents on aggregates and 50 cents on labor for each cubic yard of concrete poured. These more than balanced the sale of materials at less than cost. The entire saving is calculated to be $1.75 per cubic yard of which a portion was given to the owner for changing the basis of the contract.

By having a Strength Specification Contract, a concrete of satisfactory strength was furnished at a lower cost than would have been required by following specifications and the contractor had control of the methods of manufacture. There was a better spirit of cooperation between the inspectors and the contractor and it was made apparent that there are no accepted standards for the measurement and the manufacture of a concrete of a given strength. The question about strength of concrete is not whether we want it but how we can handle it.

The Highest Concrete Road

The highest concrete pavement in the United States is in Santa Fe, New Mexico. A concrete street in that city is 7,070 feet above sea level. The lowest concrete pavement is a road in Imperial County, California, along the Salton sea. The pavement is 150 feet below sea level.

EVALUATING AGRICULTURAL LIMESTONE PRODUCTS

By F. E. Bear
Director Soils Department, Ohio State University

SOME ten years ago it seemed desirable to rewrite the agricultural lime and limestone law of Ohio in order to give adequate recognition in the law to ground limestone as a soil improving agent. While ground limestone was mentioned in the law then in effect, neither the consumers nor the producers of this product were adequately protected by its control provisions. The proposed new law undertook to set certain standards as to fineness of agricultural limestone and to have the analyses of the various liming materials stated in such terms as would permit of adequate comparison of them on the part of the consumer.

In passing the agricultural committee of the legislature the proposed law underwent some minor revisions in an effort to protect the owners of movable crushers. As finally passed, the law required from the manufacturer or dealer a chemical analysis stating the minimum percentages of calcium carbonate, and the percentages of the total material that would pass 100, 50, 10 and 4 mesh sieves, respectively.

The law also recognized three terms that were to be employed in the naming of agricultural limestone products on the basis of their fineness, viz: "agricultural ground limestone" for a product of such a degree of fineness that 95 per cent would pass a 10 mesh sieve, 50 per cent a 50 mesh sieve and 30 per cent a 100 mesh sieve; "agricultural limestone meal" for a product of such fineness that 100 per cent would pass a 4 mesh sieve, 80 per cent a 10 mesh sieve, 30 per cent a 50 mesh sieve and 20 per cent a 100 mesh sieve; and "agricultural limestone screenings" for a product of such fineness that 100 per cent would pass a 3 mesh screen.

Ten years of experience with this law has shown its weak points. However, when one attempts to restate the law in terms of experience with it and in anticipation of future developments in soil and plant research as well as in improved technique in the production of agricultural limestone, he is faced with great difficulties. Some of the problems that are involved will be discussed in this article.

Beginning first with the statement as to chemical analysis of agricultural limestone products, the Ohio law differs from those of other states in requiring the percentages of the elements calcium and magnesium instead of their oxides. There is no reason why these percentages should not be expressed as the oxides if there was any desire for this change. Probably in the interest of uniformity with other state laws this change should be made.

Considerable objection has been raised on two scores to the use of "neutralizing power in terms of calcium carbonate." First, the term seems to be confusing to farmers many of whom have difficulty in understanding how a dolomitic stone may have a neutralizing power of more than 100. Secondly, in the competition between sales managers of high-calcium and dolomitic limestones, considerable further confusion is developed on the part of purchasers when the salesman of high-calcium stone points out that the higher neutralizing power of dolomitic stone is more than offset by its lower rate of solubility, which in carbonates water, is for pure dolomites roughly only 50 per cent of that of pure calcium stones.

The question of solubility of limestones, whether high-calcium or high-magnesium, is so tied up with the matter of fineness that it cannot well be considered apart from the screen test. It happens, furthermore, that the term "neutralizing power in terms of calcium carbonate" is applied to all liming materials including burned lime, hydrated lime and re-carbonated lime and that in these forms the magnesium products are very much more soluble than the calcium products. In fact pure magnesium oxide is 18.6 times as soluble in carbonated water as is calcium oxide. When a dolomitic limestone is burned the compound molecule undoubtedly is split into the two component oxides with the liberation of carbon dioxide.

In view of these complications and others to be mentioned later, it is apparent that neutralizing power alone is not adequate for making comparisons between two products of the same degree of fineness. However, the term is of such evident importance in arriving at comparative values of various liming materials from the same or similar stones, that it seems best to reserve the question of relative solubilities of high calcium and high magnesium stones to be considered. Whether the solubility is high or low, rapid or slow, the neutralizing power is there and in shorter or longer time exercises its full effect. A table of comparative neutralizing powers must be examined for what it is and not for something else which it does not claim to be. It is only one of several properties which must be considered in the choice of liming materials.

The matter of fineness in relation to the effectiveness of agricultural limestone is manifestly of paramount importance. The writer of the Ohio law could find little to guide him in setting standards as to fineness for the various products which

*Presented before the National Agatone Association Annual Meeting, West Baden, Indiana, January 18, 1928.

it was intended that the law should recognize. However, no great damage is done either to the consumer or the producer by setting standards which must be met if a given name is to be applied to a product.

The most important problem, and one that cannot be settled by legislation is as to what fineness is worth. Knowing what the sieve test for any product shows, how proceed to evaluate it? The National Limestone Association saw the importance of finding an answer to this question. It recognized that a few thousand dollars which otherwise might be invested in plant equipment that would soon be obsolete or in a false educational campaign that would later have to be corrected.

Neutralizing Capacities of Equal Weights of Liming Material

Assuming Chemically Pure Materials	Relative Capacity*
Calcium carbonate or limestone	100
Calcium oxide or burned lime	179
Calcium hydroxide or hydrated lime	135
Calcium-magnesium carbonate or dolomite	108
Calcium-magnesium oxide, magnesian lime	207
Calcium-magnesium hydroxide, magnesian hydrated lime	151

The Association, therefore, undertook to support a fellowship at The Ohio State University which has now been under way for nearly five years at a total cost of approximately $8,500. It might be well to add that the University has invested at least an equal amount in personnel, buildings, equipment and chemicals in this project. Three rather exceptional young men have worked on various phases of the problem. The combined contribution of these men and of the members of the Department of Soils of The Ohio State University will be ready for publication sometime within the next year. Certain phases of the work already accomplished will be considered in this report.

Preliminary studies by the department showed that there is no apparent relationship between rate of solubility and any physical characteristic of limestone except fineness of division. Contrary to what had previously been believed, porosity and softness were found to be of no appreciable significance. Further studies confirmed what had been frequently reported, viz: that magnesian stones are more slowly soluble in water and more slowly effective in the soil than are high calcium stones of the same degree of fineness. This means that fineness of grinding is more important with dolomitic stones than with high calcium stones.

Since fineness is of very evident importance it was decided to attempt to evaluate limestone in terms of their fineness by the use of some one figure for each product, this figure to express relative effectiveness and to be used for comparative purposes. For immediate time, this figure would represent the combined surface area of all of the particles contained in a unit weight of the product. If, however, consideration is to be given to the effect produced in the soil at the end of some period of time, say a year, then this figure must represent the percentage of material that would dissolve in that period. While the amount that dissolves in a given time is proportional to the fineness of division of the particles and the total amount of surface which they expose to the solvent action of the soil water, it must be remembered that the surface is constantly changing as a result of this dissolving process. Small particles disappear entirely and large particles become smaller.

We shall confine our attention first to the problem of evaluating ground limestones on the basis of their immediate surface without reference to what may happen to them when they are applied to the soil. In this problem one finds no difficulty, if he assumes that all of the particles are spheres, cubes, pyramids, or any regular or irregular shape that might obtain. Cutting in two any linear dimension, for example, the diameter of spheres doubles the surface area if the issue is kept constant. If we take any composite sample of limestone of which we know the sieve test we have a relatively simple method of procedure to determine the relative surface of all of its particles as compared to the surface that would be exposed if all of the particles were of one diameter chosen as a standard for comparison. Setting the 100 mesh product as our standard, considering for the moment that all of the product finer than 100 mesh is 100 mesh material and assuming that all of the product passes a 4 mesh sieve, the figure representing the surface area is made up of the sum of the products secured as follows: (100 mesh $\times$ 1) + (48 mesh $\times$ ½) + (14 mesh $\times$ ⅛) + (8 mesh $\times$ 1/16) + (4 mesh $\times$ 1/32).

Is it safe to assume that nothing is gained in practice by grinding any part or all of the product finer than is required to pass a 100 mesh sieve? In so far as solution studies in the laboratory are concerned, it is evident that continuing to cut the linear dimensions in two doubles the surface area and the rate of solution until a point is reached at which the particle is so small that solution is instantaneous. It is known also that the maximum rate of solution in the soil does not occur with products which only pass a 100 mesh sieve if precautions are taken to mix the limestone thoroly with the soil. However, in practice, no such thorough mixing as can be done in the laboratory takes place. The limiting factor in the rate of the effectiveness of ground limestone in the soil finally becomes the efficiency of the machinery of distribution rather than the fineness of the product. We believe that a safe basis for comparison of the immediate surface of limestone products is that of setting the 100 mesh product as a standard with a

*Neutralizing capacity of 100 pounds of pure material in comparison with an equal weight of calcium carbonate.

value of 1 for each per cent which passes that screen.

It is of interest to note in this connection that limestone products are now offered for sale at delivered prices, in Ohio, that, without design on the part of the producer, are practically based on the above method of evaluation. Taking any ground limestone product and multiplying its "relative effective surface" by 7, one has the approximate delivered price of the product in bulk. For sacked products, $1.50 per ton must be added to cover this additional expense. Thus a product all of which passes a 100 mesh sieve is laid down at the farmer's station at an average price of approximately $8.50.

Comparing two products of which the screen test might be as follows we have their comparative surface areas as indicated below.

Relative Effective Surface Areas of Two Limestone Products

LIMESTONE I

Mesh*	Per Cent	Factor	Product
100	70	1	70
48	10	1/2	5
28	10	1/4	2 1/2
14	5	1/8	5/8
8	5	1/16	5/16
4	0	1/32	0
Relative Effective Surfaces.....			78 7/16

LIMESTONE II

Mesh*	Per Cent	Factor	Product
100	30	1	30
48	20	1/2	10
28	20	1/4	5
14	15	1/8	1 7/8
8	10	1/16	5/8
4	5	1/32	5/32
Relative Effective Surfaces.....			47 21/32

It is desirable to keep in mind the limitations of the above method of calculation of "relative effective surfaces." First, material finer than 100 mesh is given no greater value for practical purposes than is that which just passes that sieve. Secondly, material coarser than 4 mesh is given no consideration since its surface area as compared to its mass is insignificant. Thirdly, the particles of all limestone products are assumed to have the same average shape. While it is known that they are neither spheres, nor cubes, nor any other regular design it is assumed that they are so irregular that the average shape of the particles of all separates of all stones is the same.

For a crystalline material, it is reasonable to assume that the particles, whether large or small, are quite similar in design since crystal habits and lines of cleavage are inherent properties. With limestones that are not definitely crystalline, no such regularity of design of particles is to be expected. To assume that the average shape of the particles of all separates of all stones, whether crystalline or not, is the same introduces an error. Theoretically this error might assume considerable proportions. Practically it is not likely to be very large.

Let us return again to the problem of determining the relative effectiveness of limestone products in the soil by the end of a given period of time. To be specific, if 1500 pounds of limestone out of 2000 pounds of a given product that were applied to a given soil dissolved in one year, how many pounds of any other limestone product would have had to be applied to that soil so that the same number of pounds of limestone would have dissolved in the same period of time?

From the laboratory point of view such a problem is relatively simple. Assuming ideal conditions for solution and regularly shaped particles, spheres for example, the reduction in diameter of all particles in a given period of time is the same no matter what their size. For example, if a particle that is .02 inch in diameter has dissolved to the point that it is .01 inch in diameter, a particle that is .20 inch in diameter is at the same time .19 inch in diameter. Each limestone has its solubility factor which must be applied, but this presents no especial difficulties.

Since limestone particles are not regular in shape and also because the solubility factors of the various limestones were not known, it was necessary to test out the theoretical values for the various sized particles. The surface factor was found not to introduce any serious error. As previously indicated, dolomitic stones dissolved more slowly than high calcium stones but this in itself offered no difficulties. However, it was found that an impure dolomite produced an irregular solution curve in that its rate of solution was at first quite similar to that of high-calcium stone and then fell off to that of pure dolomite. Further investigation showed that this stone was made up of two definite compounds, viz: calcite and dolomite. The solution rate at first observed was the combined rate of calcite and dolomite and later that of solomite alone. As the infiltrated calcite dissolved, the particles of stone broke up into a number of smaller particles thus further reducing the sizes of the particles and increasing the area of surface exposed to solution.

While this type of irregularity offers some experimental difficulties it is still possible to determine the necessary factor that must be applied to such a product in comparing it with any other limestone product. One may say, therefore, if the conditions in the soil were the same as they are in a constantly stirred dissolving liquid, one could calculate how much of any given limestone prod-

*The diameters of the openings double for each succeeding sieve.

uct would have to be applied to have the same effect as a given quantity of any other limestone product by the end of any period of time that might be decided on. It is apparent that such a figure would be of considerable practical value.

In the application of this principle to the soil certain difficulties are encountered. Soil is not being constantly stirred. It is a mixture of solid, liquid and gaseous phases. When limestone dissolves it must diffuse from the point of solution into the soil before more of it can dissolve. While gravitational and capillary water may play some part in this removal process, it is evident that diffusion plays the principal role in the removal of the dissolved calcium and magnesium from the immediate vicinity of the limestone particles at least during dry weather. On investigation of this matter one finds that a given amount of surface exposed by fine particles is in contact with a larger volume of soil into which it can diffuse in a given time than has the same amount of surface in the form of larger particles.

If one applied two tons of 100 mesh limestone to an acre of soil and mixed it thoroughly with the soil to plow depth (6 2/3 inches) each of the 424 billion particles of limestone would be the center of a cube of soil containing 1.61 cubic millimeters. As the limestone from any one particle dissolves and moves through the soil by diffusion it must in time come into contact with limestone that has dissolved from the neighboring particles. The diffusing distance before this meeting occurs would be 0.5124 m.m.

To apply as much dissolving surface in the form of four mesh particles would require the use of 64 tons of limestone. But the volume of soil that lies within 0.5124 m.m. of the surfaces of all of these four mesh particles when equally distributed in the soil is only a little more than 1/20 of that lying within this distance from the surfaces of all the particles of the two tons of 100 mesh material. That is, the volume of soil in the zone of diffusion of the 64 tons of four mesh particles is to the volume of soil in the zone of diffusion of the 2 tons of 100 mesh particles as 1 is to 20.

Consideration of this point shows that this works to the disadvantage of the large particle so that its relative rate of solution in the soil is much slower than is the case when it is suspended in a liquid dissolving medium that is being constantly stirred as is the case in laboratory solution studies.

The matter of diffusion does not present any especial difficulties mathematically since here again a constant can be applied in the equation for each particle size. It is necessary to keep in mind, however, that the diffusion constants for calcium and magnesium will not be the same. The composition of the stone in relation to the degree of saturation of the soil complex with respect to both of these elements must be taken into consideration as another factor to be dealt with.

As a resumé of the problem of evaluating limestones on the basis of their relative efficiencies in the soil at the end of a given period of time, we find that consideration must be given to four constants in the equation that must be applied. The first constant has to do with the shape of the particle and is the ratio between the surface area and the diameter of the particle. The second constant is that of solubility in which consideration must be given also to the fact that impure dolomites may be mixtures of calcite and dolomite. The third constant is the time factor in which consideration must be given to whether the desired result is to be secured at the end of 3 months, a year or some other period. A fourth constant is that of the rate of diffusion in the soil in which the size of particle and its content of calcium and magnesium in relation to the saturation of the soil complex with respect to these two elements must be considered.

Another matter normally to be considered, although somewhat apart from the matter under investigation, is the buffer capacity of soils as a result of which it is necessary to apply more limestone to silt loams than to sands, more to clay loams than to silt loams, and more to muck soils than to clay loams to produce a given change in effective acidity.

Considering the complexity of the problems, we are inclined to the belief that the best that can be suggested today as to the adoption of further standards in evaluating the various agricultural ground limestone products is that previously indicated, viz: classifying them on the basis of their "relative effective surfaces" as they leave the plant rather than as to the effect which they will have produced in the soil a year hence.

We need to continue the investigation of the variables that are involved which have to do with the efficiency of limestones and other liming products in the soil as related to the well being of the various crops. Later it may be shown that a third number can be added to the one now in effect (neutralizing power in terms of calcium carbonate) and the one proposed (relative effective surface) which will permit of more accurate practical evaluation of limestone products on the basis of their effectiveness. In our opinion, we are still a long ways from knowing what this factor number, or combination of factor numbers, should be.

Porous Concretes

Foam producing and other materials are used with cement, clay or like products to obtain porosity. Glue, albumin, casein, resins, cellulose compounds, rubber, glycerine, phenols, formaldehyde and other substances may be used in various proportions. J. A. Rice (British Patent 263,571).

HOW A LABORATORY WILL BENEFIT THE CRUSHED STONE INDUSTRY

By A. T. Goldbeck,
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IT IS now very definitely assured that the crushed stone industry will have a research laboratory which will be started in operation within a period of a few months. Never has the association made a wiser move than that which has resulted in its taking definite steps to investigate its own product. The history of research in industry has always been one of positive progress and if past experience in other industries is repeated with us, we have every reason to believe that the expenditures we shall make for research will amply repay us.

The National Industries Conference Board has stated that industrial research by corporations and by the federal government now represents an annual expediture of $200,000,000. Of this amount industry spends two dollars for every dollar spent by the government. To demonstrate the growing esteem for research by industry we are told that, "Whereas, in 1921 only 578 companies were known to maintain research departments or laboratories, more than 1,000 companies have organized research divisions in operation at the present time. In addition, 70 trade associations are spending about $15,000,000 a year in research and 152 colleges and techical schools about $1,500,000. Much technical research work is also accounted for as part of the production costs of industrial organization and not included in the total sum here given. Industries whose research expenditures were largest five years ago are those which have scored the greatest relative growth since then. One manufacturing company in 1926 spent $5,250,000, while a public utility corporation spent approximately $13,000,000 within the same year. Manufacturing companies were found to spend on an average of from one to three per cent of gross receipts from sales on research."

E. J. Mehren, Vice President of the McGraw-Hill Publishing Company, has made the following significant statement:

"I hold out to you a promise, future industrial success, if you employ research, and I hold a threat, industrial lameness and decay, if you neglect it.

"Back of the immediate and commercial types of research there must be another type, deeper in character, which is concerned with pushing back the boundaries of the unknown. On the results of this more basic form of research is built all of the great development that has made for the progress of the world since history began. Investigations of this type cannot be controlled. It is not possible to know beforehand what the result may be. It must suffice the investigator to know that there should be a result, either positive or negative. This type of research is to industry what the telescope is to the astronomer. The field is limitless.

"It is the responsibility of every American business executive to give generous support to cost reduction efforts and to industrial and scientific research."

So you can rest assured that all precedent supports the step you have taken and should remove any doubt as to the wisdom of investing your money in research for the benefit of your industry and those whom it serves.

What Can Be Investigated?

Problems requiring investigation will immediately occur to all of you, and I shall always welcome your advice as to the problem with which you are confronted. Certain questions can be answered by laboratory researches which we can undertake; others must be left to governmental, state, and university laboratories having special facilities, while still others cannot be solved in the laboratory but must be undertaken by statistical methods and by investigations in the field.

The following problems occur to me as needing solution and I have attempted to list them in the order of their importance to the industry as a whole:

I. What is the effect of coarse aggregate on the transverse, tensile and compressive strength of the concrete?

Such an investigation will answer the following typical questions.

(a) What cement content and proportions of fine and coarse aggregate having various characteristics will result in the same cross-bending strength of concrete?

In explanation of this question, let me tell you that the resistance of concrete to cross-bending is now considered the most important property highway concrete should have, because concrete road slabs crack and break up largely because their cross-bending resistance has been exceeded. It is now almost the universal practice to specify concrete proportions by volume, irrespective of the resulting difference in cross-bending strength, irrespective of the difference in voids in coarse aggregates which results in more cement per cubic yard of concrete in one case than in another, and irrespective of differences in workability. The ideal for which the engineer should aim is the pro-

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duction of dense, durable concrete having a given cross-bending resistance and this will require different proportions for the various aggregates. It would be of very great value to us if we had information on the effect of the coarse aggregate on the proportions of concrete necessary to produce the same cross-bending transverse strength.

(b) What is the best gradation of stone for the greatest yield and strength of concrete?

In competition with other aggregates, it is desirable to so grade the coarse aggregate that a high yield of concrete or a low cement factor will result. Therefore, it is important that we obtain specific information on the best gradation of stone that will accomplish this purpose. Especially is this problem important in view of the increasing tendency to require the shipment of stone in two or more sizes later to be recombined in the best proportions for highest strength and highest concrete yield.

(c) What is the effect of increased stone content on the transverse strength of concrete?

This problem also has to do with the shipment of stone in several different sizes for later combination in the best proportions and will give us definite information on whether we should consider plant alterations to best make this type of shipment. It is desirable that we be forearmed with information which will indicate to us the trend which specifications may take.

II. What is the effect of repeated stress on concrete having different kinds of coarse aggregates?

Thus far all comparisons of coarse aggregates have been made on the basic of strength tests, either compression, cross-bending or tension in which the load has been applied slowly until failure takes place. In concrete roads, however, loads are not applied once, they are applied hundreds of thousands of times due to the passage of vehicles, to the effects of temperature and moisture changes, and to the effects of variations in support offered by the subgrade. What is the effect of these repeated loads on concrete in which the coarse aggregate varies from smooth, rounded fragments to rough angular fragments? Such an investigation will throw light on the proper unit stress to be employed in the design of concrete roads when the aggregate is different in one case than in another. Thus, we shall obtain more definite knowledge on the relation of the thicknesses necessary to produce the same resistance to the loads of traffic and other repeated loads, as this relation may be altered by the characteristics of the coarse aggregate.

III. A study of the effect of aggregate on workability of concrete with the idea of determining how to proportion stone concrete for the highest workability. In explanation, it is not so well known that harsh working concrete may be improved in workability, and without decreasing its strength, merely by the addition of more sand and without necessarily adding more cement. More information is needed along this line.

What are the laws which will make for equal workability when different coarse aggregates are used? I believe it will be possible to determine how to proportion stone concrete so that it will always be highly workable and at the same time will be not lacking in strength and economy.

IV. What is the real effect of dust coated stone on concrete? This question has never been definitely answered and it is one which often causes trouble when stone is produced in wet weather. Some specifications limit the percentage of stone dust by weight. What are the real facts? What is the maximum amount of dust which should be permitted? Is it going to be necessary to wash stone? Let us get the answer by a well laid out series of laboratory tests.

V. Study the question of soundness of aggregates. Under this study would come such investigations as studies of the various accelerated soundness tests such as the sodium sulphate test, sodium chloride and the boling test versus freezing and thawing tests, not only on aggregates but also on concrete made with these aggregates. At the present time there are plants producing enormous quantities of aggregates which fail in the sodium sulphate test for soundness and yet these aggregates are giving good service. None the less it is frequently the case that aggregates are rejected merely because they show unsoundness in the sodium sulphate test. A study to develop a truly suitable accelerated soundness test which agrees with service results would be well worth while and would remove the stigma from many limestones which are now thought to be unsound merely because of the effect of the sodium sulphate test.

Certain aggregates contain a small percentage of deleterious material and among the questions which arise are, What are deleterious substances and what percentage should be permitted?

VI. Study the stability of bituminous concrete mixtures containing various coarse aggregates. In explanation, it might be stated that crushed stone inherently is the most stable coarse aggregate which can be used in bituminous mixtures because of its rough surfaces and interlocking effect, but it would be of value to obtain a quantitative measure of stability or resistance to shoving under traffic of various bituminous concretes made with different materials in order that definite laws may be set up governing the proper proportioning of such mixtures. What is the effect of the degree of angularity and roughness of the coarse aggregate and how do these affect the stability and the proportions of the mixture necessary for the higest stability?

VII. How do the physical characteristics of the various coarse aggregates compare throughout the country? We should have definite information on the physical characteristics of competing aggregates. We already have abundant information on stone in the published reports of the United States Bureau of Public Roads, but corresponding reports

have never been published on gravel nor on slag, although much of this information is in existence. On the other hand, much of it is lacking and as a routine feature of the laboratory we should continue to collect samples of materials of various kinds in order that we might be in a position to compare their various physical characteristics. A study of competing materials is quite as necessary as a study of our own material.

VIII. Study the merits of stone sand for use as a fine aggregate in concrete. This question is one of importance to a number of producers, especially in those localities where sand is expensive. A study of the best gradation of stone sand for the highest strength, yield, and workability would be of value and, in general, a study of the use of screenings, particularly in concrete products, would be of value, to show the advantages of this material. Studies for the purpose of designing concrete having given characteristics for use in products should likewise be made.

IX. Study the question of segregation and means for preventing it. This problem has never been studied in a systematic way. It would seem that laboratory tests may serve a very useful purpose in overcoming what now is a very troublesome question in most stone plants.

X. Special tests made for particular purposes, such as the design of concrete mixes for given strengths when particular materials are used. I have in mind that the laboratory may be useful in determining the most economical proportion of concrete for given jobs where it is desired to obtain strength results with the greatest economy. Work of this kind can naturally only be carried on to a limited extent and preferably in connection with the main research program.

Other problems may occur to a number of you as they also occur to me and, unquestionably, important questions will arise as the work proceeds.

Suggested Policy of the Laboratory

It must be quite apparent to all of you that with the funds available we shall have a very limited personnel. Every dollar and every minute will have to be used with telling effect. The work, therefore, must be laid out in the form of research programs so designed that they will give the answer to questions which are troubling the greatest number in the industry. By no means should the laboratory be used to compare the relative merits of one producer's product with another's and technical papers issued from the laboratory should avoid direct mention of the name of a particular producer. When it is necessary to describe the stone used in investigations it probably should be done by general geographic location and by its physical characteristics.

The whole question of policy may be summed up in the statement that the laboratory must be operated for the good of the entire industry and not for the particular benefit of any company or group producers in their competition with other producers of crushed stone. It is plain to see that any other policy would be disastrous, but I know from experience that I may rely on your wholehearted co-operation to the end that the research work may be conducted for the good of all. I wish to congratulate you on your decision to participate in research and to express the hope that its usefulness will soon be made evident to every producer.

Manganese in an Ancient Lake

Manganese is a constituent of most rocks and is readily dissolved in ground water and reprecipitated. In the belt of lakes that lie along the south edge of the area covered by glaciers in the northern United States during the continental glaciation manganese and iron oxides have been found, here and there, in quantities that warranted mining. Most of these deposits have not yet been covered by sediment, but there was recently discovered in southern Idaho a minable bed of manganese oxides that have been deposited in a lake of the glacial period and later covered by 100 feet of silt. Up to May 1, 1927, it had yielded 1,200 tons of high-grade manganese ore.

Asbestos-Cement Mixture

In an apparatus for preparing a wet mixture of asbestos and cement for feeding to a machine producing sheets and boards, the dry material, after preliminary mixing, is fed to a breaker together with a stream of water, the wet mixture being then delivered to a head box together with more water obtained from the back water of a forming machine to which the wet mixture is supplied; the back water is fed to a clarifying device, the nonclarified water being used for adding to the dry material before it enters the breaker. Hancock and Macmenigall, South Africa, (British Patent 280, 436).

Artificial Stone

Organic fibres are treated with a water glass solution to which about 1 per cent. of turpentine oil has been added, a reagent which will precipitate an insoluble silicon compound on the fibres is then applied and a binding-agent such as cement is then added to form a mortar-like mass. Fillers and coloring agents may be added to this product; it may also be reinforced by means of wire, long fibres, strips of fabric, etc. Waterproofing agents may also be added, or the finished articles may be treated by impregnating or painting processes. Tracksel, Wiedmer & Zigerli (Switzerland) British Patent 280, 104).

BITUMINOUS TOPS FOR OLD ROADS

By A. H. Hinkle,
Indiana State Highway Commission*

RESURFACING of old roads which have sufficient gravel, stone or other kind of crusted metal in them to furnish a material support for a new top deserves the serious consideration of everyone interested in conserving the resources of those who pay the highway bill.

In resurfacing roads, the alignment, grade, widening on curves, superelevation, etc., are things which must be given consideration. It is imperative that these be made to conform with modern standards to safely accommodate the present heavy and high speed traffic. Hence, where old roads are lacking in proper location, alignment, and grades, it happens sometimes that little of the old road can be salvaged. However, frequently and we may say more frequently in future years, there is much of the crust of an old road that can be salvaged as a base for some kind of a new top. It is such roads or parts of roads as warrant salvaging to which my remarks are directed in this paper.

For this resurfacing work there are multiudinous kinds of materials or combinations of materials of which the most common is some form of macadam or bituminous mixtures.

Waterbound Macadam

In our eagerness to invent something new we must not neglect the value of a properly built waterbound macadam to be used in leveling up an old base for the new top; or to be given a bituminous surface treatment and serve as a finished road surface where the traffic is light. Even where a fairly heavy auto traffic is to be carried this type may be economical for a period of years. There are many varieties of surface treated waterbound macadam, some good and some poor. I am not advocating this as a substitute for the other types which I will describe later but do not wish to neglect its merits under certain conditions when properly built, protected and maintained.

Bituminous Mixtures or Combinations

There is a great variety of bituminous mixtures and combinations used as a road surface and even for some base work. These might be classified according to methods of making, into:

(a) Plant or pre-mixtures;

(b) Field mixtures (mixture made on the road surface) which may be subdivided into:

1. Surface Treatments,
2. Mulch Mixtures,
3. Retread Tops,
4. Penetration Tops.

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Under the plant or pre-mixture may be classified sheet asphalt, Topeka mix, open mix, bituminous concrete, the various kinds of cold mix, Amiesite, rock asphalt, etc. I will confine my paper principally to the mixtures made on the road surface and not further discuss these pre-mixtures except to state that in all bituminous mixtures, either plant or field, it is necessary to incorporate just enough material to serve as a binder and prevent the aggregate from raveling and at the same time avoid using so much of the bituminous material as to cause waving and rolling of the mixture under traffic during hot weather. There may be a very narrow range within which the percentage of bitumen can vary. The kinds of aggregate, bitumen and traffic may be such that there will be no overlapping of the percentage of bitumen that will prevent raveling with that which will prevent rolling and waving, in which case there can be no suitable mixture made. This principle applies just as well to the mixtures made on the road surface as to those made in a plant and afterwards spread upon the road. With a plant mixture the proper proportions of quantities can be measured or weighed and if the proper quantities are previously known, theoretically they may be put together exactly as wanted. With the mixture made on the road we have to put into effect to a greater degree the cut and try method, because the sizing and quantity of loose material are not always so definitely known since by their very nature they are more of an uncertain quantity. However, with a skilled and trained operator the cut and try method has certain merits which may make it even more possible to get a proper mix than by measuring the exact quantities that go in the mixture.

1. Surface Treatments. The method of surface treating a hard stone road, previously swept clean of dust and dirt, with a bituminous material and covering the treatment with a suitable aggregate is so well known that I will say but little about it here. Perhaps the greatest advancement that has come about with this process in recent years is the dragging of the road surface with a long base drag after the covering material has been applied. This dragging process, in shoving the aggregate used as covering around over the road surface, coats each small piece of stone with bitumen, thus virtually making a bituminous mixture. This is deposited by the drag in the low places which levels the old surface. Thus each successive surface treatment not only serves to renew the wearing surface, but also relevels it.

It is possible that a penetration road may get

smoother in future years with successive surface treatments, provided the road has a good base to start with. Much of the roughness that develops under traffic on the macadam type of road is due to insufficient base for the traffic that is carried. An important thing in surface treatment maintenance is to use a comparatively coarse covering. In fact, generally speaking, the coarser the better so long as an objectionable rough surface is not produced. Also the coarse covering aids in making a more non-skid surface which is a very desirable safety feature on steep grades and on curves. If additional covering is applied late in the summer on a surface rich in bitumen, frequently a pebbly surface may be produced for winter traffic when a slippery surface is most objectionable.

2. Mulch Mixtures. Mulch mixtures are made by treating on the road a layer of fine, loose material of gravel or stone with a light tar or cut back asphalt. The mixture is worked across the road and back by the use of a grader or road maintainer. Successive treatments and mulching the mixture around on the surface is continued until thoroughly mixed and then the mixture is uniformly spread over the surface and compacted with a roller or by traffic. Some excellent results have been secured by this process. However, the process has its defects two of which are: (1) The potting and breaking up of the surface under heavy trucking in winter and during spring thaws; (2) The shoving and waving of the surface due to an excess of bitumen or fine aggregate in spots. The method of construction makes it difficult to maintain an even mixture of the fine and coarse aggregate and if enough bitumen is put on in one place to prevent raveling, too much will exist at other places and cause waving. Experience has shown that where the loose material was uniform and fine material absent, far better results were secured.

This led to the use of 1½ inch or 2½ inch size stone and the building of a surface which has been designated a "retread" top, for want of a better name, and which might be described briefly as a top midway between the mulch mixture and a penetration macadam. In fact there is no exact line of demarcation between the four methods listed above, the one gradually merging into the other.

3. Retread Top. This type of field mixture is described in detail as the principal part of this paper, and is presented in the form of a specification for this top. In building a retread top a great variety of combinations can be made. In the following specification it is attempted to describe several of the combinations that have proven most satisfactory in our work.

Specifications for Bituminous Retread Top

1. Description. This bituminous retread top shall consist of a mixture of bituminous material and crushed stone, slag or gravel, made by applying successive applications of the bituminous material to a layer of aggregate spread on the old road to a smooth surface and a uniform crown and grade. The mixture is kept smooth and uniform by the use of a grader or planer if necessary, until the bituminous material hardens sufficiently to cause the stone to compact under a roller. The aggregate is rolled after each application of bituminous material when the bituminous material is in the proper stage of curing. The surface voids that cannot be closed by rolling, after the second application of bituminous material, are closed by the addition of No. 4 aggregate.

2. Preparing the Old Road as a Base for the Retread Top. The old gravel or stone road shall be leveled and trued up by dragging and scraping. A coat of No. 3 or No. 2 aggregate shall be applied if necessary to strengthen the old base. Scarifying before leveling may be resorted to if there is an abundance of coarse aggregate in the the old road. (However, since the old road is usually weak, it will generally be found more economical to build up the low places rather than cut down the high places.) After the old surface has been brought to proper grade and crown and after a sufficient thickness of base metal has been obtained, and the base is compacted either by traffic or rolling, the road is ready for the retread top. (If metal is added to level and strengthen the old base, it is preferable that it be done several months in advance of putting on the retread top so that a smooth and uniformly compacted base without much loose fine material thereon will result.)

If there is any material amount of fine aggregate such as sand or crushed stone on the old road after it is prepared for the retread top aggregate, same shall be uniformly distributed over the road surface so that it will not work up into the coarse aggregate non-uniformly. (Any spots in the coarse aggregate that are filled with this fine aggregate will likely develop into "fat" spots after the bitumen is applied. Such spots will be a source of trouble later on.)

3. Bituminous Materials. The grade and amount of bituminous material used in this work shall depend upon the depth and grade of aggregate. (No more shall be used than just sufficient to prevent raveling of the surface.) The table in paragraph 9 shall be used as a guide in determining the quantities to be used. If the aggregate contains much fine material, the first coat of bituminous material should be liquid asphalt ACG, Tar TC or TCM instead of the grade given in the table. The successive coats of bitumen shall follow each other just as soon as time for curing of the preceding coat has been allowed. Distributor and application shall comply with specifications in Item 5 for bituminous macadam top.

4. Covering Material. Covering material shall consist of Grade A crushed stone, slag or gravel,

size No. 4 (1 inch to ¾ inch). No covering material shall be applied just after the first coat of bituminous material. If the aggregate is No. 2 size or coarser, a small amount of covering may be applied just preceding the second application of bitumen.

The amount of No. 4 covering required will depend upon the size and hardness of aggregate that has been used. It may range from one cubic yard to 150 square yards of surface where No. 3 aggregate has been used, up to one cubic yard per 100 square yards of surface where No. 2 aggregate has been used.

5. Spreading of Coarse Aggregate, for Retread Top. The road shall be coated with one inch to three inch of No. 2 (1½ inch to 2½ inch) or No. 3 (1½ inch to ¾ inch) Grade A crushed stone, slag or gravel. This loose aggregate may be spread direct from the trucks but shall be leveled with a road grader and maintainer so that it conforms to the proper crown and grade without any dips or irregularities. This loose material, if of size No. 2 and a hard stone, shall be smoothed and compacted with a ten ton three wheel roller just preceding the first application of bituminous material. If the aggregate consists of No. 3 size, this rolling before the first application of bituminous material may be omitted. If a comparatively soft aggregate is used, this rolling shall be omitted on the No. 3 aggregate and may be omitted on the No. 2.

6. Applying the First Coat of Bituminous Material. To the aggregate uniformly spread as described above shall be applied the first coat of bituminous material. The aggregate may be rolled once while the bitumen is quite soft so that the maximum smoothing effect of the rolling will be secured. This coated aggregate shall then be permitted to cure until the bituminous material stiffens or becomes just sufficiently hard that it will not be unduly displaced by the rolling. (The curing period before extensive rolling will vary from a few minutes to several days, depending on grade of bitumen used and atmospheric temperatures.)

Any portion that has been disturbed by traffic or the distributor wheels to such an extent that the roller will not relevel same, shall be leveled either by hand or a road grader or maintainer just before rolling. As soon as the bituminous material is sufficiently hardened that the stone will compact well and remain so under the rolling, it shall be thoroughly rolled with a ten ton three wheel roller. The wheels of the roller shall be sprinkled with water during the rolling, sufficiently to prevent the bituminous material from adhering to same. This provision shall be carried out in all successive rollings. This rolling cannot be completed at one time but must be extended over several days in order that the aggregate will assume a proper position and remain bonded in place after the rolling is completed. The bulk of the rolling shall be done when the bitumen is sticky and stiff enough to hold the stone in place but not sufficiently dried as to become hard and brittle.

7. Applying the Second Coat of Bituminous Material. After the first coat of bituminous material has sufficiently hardened so as to prevent the aggregate from being greatly disturbed by the roller or distributor wheels, and the surface has been thoroughly rolled, the second application of bituminous material shall be made. After this application, and when the bitumen is in the proper curing stage, the rolling shall be continued in sufficient amount to thoroughly compact the aggregate and eliminate all irregularities and depressions. Any depressions and irregularities which cannot be eliminated by rolling shall be removed by the addition of aggregate of the same size as used in the top course and which has been previously coated with asphalt or tar. This rolling and leveling process shall continue until a true and uniform surface results and the bituminous material has sufficiently hardened so that the surface will resist longer being distorted by the roller or distributor wheels. The time of this curing process and rolling will vary from one to five days, depending upon the grade of bituminous material used, and the temperature at the time the work is being done.

After the surface has become solid and just preceding the application of the third coat of bituminous material, the voids in the surface shall be uniformly filled with loose No. 4, Grade A covering. No rolling or traffic shall be permitted on this loose covering before the third application of bituminous material. (These voids can best be filled by uniformly spreading same on the surface and sweeping them with hand brooms or with a broom dragged behind a light truck or car. If an extremely hard stone is used for covering and the coarse aggregate shows very open voids, part of this covering may be applied just after the second application and before the rolling is completed. However, care shall be taken not to close up the voids too early as the bitumen down in the mixture must have time to harden before closing the surface voids; also any excess of covering and bitumen may be the source of waving and rolling later on.

8. Applying the Third Coat of Bituminous Material. After the voids have been filled with loose No. 4 aggregate as described above, the third application of bituminous material shall be made. After the third coat of bituminous material has been applied, it shall be covered with additional No. 4 aggregate, after which the surface shall be thoroughly dragged with a long base metal blade drag or planer. The surface shall then be again thoroughly rolled, after which it can be opened to traffic. If under traffic the surface does not sufficiently close up to eliminate danger of raveling, another coat if bituminous material and No. 4 cover-

ing may be added, preferably just before the road goes into the winter season.

(The greatest precaution that must be taken with this type of work is to avoid building up a rich mat of bituminous material and fine covering. For this reason no sand or limestone dust or fine aggregate finer than No. 4 should be used in building up the surface. Any material amount of dirt, dust, sand or other fine aggregate with the bitumen is very likely to produce a soft, mushy mixture which sooner or later will wave and roll under heavy traffic. For this reason it is always best to be conservative on the amount of bituminous material used, keeping in mind that a little additional material can be added at any time, while if too much is applied, it is impossible to remove the excess. Difficulty from a slight excess of bitumen can be partially corrected by the addition from time to time of hard No. 4, or coarser, covering permitting traffic or the roller to force same into the soft, mushy surface. While this is a partial corrective remedy for the excess bitumen, it is always best to avoid in the first instance the condition which will cause the waving and rolling of the surface. On heavily traveled roads there is more danger of using an excess of bitumen then on roads with light traffic.)

from time to time if it shows signs of being too rich with bitumen.

Keeping the surface that shows signs of an excess of bitumen constantly covered with No. 4 covering to be beaten in by traffic will greatly aid in reducing the tendency for the surface to wave and roll. This covering material dilutes the excessively rich mixture.

Methods of Maintaining Retread Top

The standard method of maintenance of this type of surface is with retreatments every year or two.

The ills and ailments of this type of surface might be classified as, (1) Waving and rolling under traffic, largely due to excess bitumen which is accelerated by fine material; (2) Breaking and disintegration of the crust, thus forming "pot" holes or a raveled surface; (3) Failure of the base which results in a rough surface under heavy traffic and eventually a breaking of the surface.

The first defect, namely, waving and rolling, can best be corrected when it becomes excessive, by scarifying that portion of the surface which is defective, thoroughly breaking up the bituminous crust and adding to it a small amount of uncoated aggregate from the base, or by the addition of new aggregate to the top. This new aggregate should

Estimate Reference	Depth of Loose Aggregate	Size of Coarse Aggregate	Aggregate Required for Different Thicknesses (Based on 2500 Lbs. Per Cu. Yard)				Gallons and Grade of Bituminous Material Required per Square Yard of Surface							
			Coarse		Covering		First Coat		Second Coat		Third Coat		Fourth Coat	
			Tons Per Mile for 20 Ft. Width	Pounds Per Square Yard	Tons Per Mile for 20 Ft. Width	Pounds Per Square Yard	Gal.	Kind	Gal.	Kind	Gal.	Kind	Gal.	Kind
A..	3 "	No. 2 (2½" to 1½")	1222	208	200	34	.45	TM or CB	.35	TH or CB	.40	TH TM CB	.2	TH TM CB
B..	2½"	No. 2 (2½" to 1½")	1019	174	200	34	.40	CB or TM	.35	CB or TH	.35	CB or TM		
C..	2 "	No. 2 (2½" to 1½")	815	139	200	34	.35	CB or TM	.30	CB or TH	.30	CB or TM		
D..	2 "	No. 3 (1½" to ¾")	815	139	160	27	.30	TM or CB	.25	TH or CB	.30	TM TH CB		
E..	1 "	No. 3 (1½" to ¾")	407	69	145	25	.25	TC TM AC CB	.25	TM or CB	.20	TM or CB		

9. Amounts of Bituminous and Covering Materials Required for Differing Amounts of Coarse Aggregate.

If the coarse aggregate should have much fine material in it, which is very undesirable, the first coat of bituminous material should consist of asphalt ACG, or tar TC or TCM. Tar TCM may be used at any time instead of TM and it has the advantage of hardening quickly. There is no value of the TCM over the TM or TH in cool weather. The No. 4 covering should be largely used just before the third coat of bitumen, the object being to fill the voids in the surface with coated No. 4 aggregate by the dragging process. Some additional covering should be spread over the surface

be thoroughly mixed with the old mixture by harrowing. After this broken up material is thoroughly mixed, it is leveled off and again rolled in place and traffic permitted to immediately go over same. If there develops symptoms of disintegration of the reformed surface a very light application of bitumen, usually not exceeding 0.1 gallon per square yard may be added to prevent surface disintegration. Some repairs of this nature have been made which seem to carry quite heavy traffic for many months without again waving or rolling. The breaking up of the old bituminous surface and adding of new aggregate either from below or above, not only dilutes the mixture that is too rich in bitumen but also permits a ventilation of

the bituminous material during which the volatile matters pass off, thus hardening the bitumen and reducing the tendency to wave and roll. Isolated wrinkles or rolls may be corrected by hand picking and tamping the mixtures back in place after the method described above.

The second defect, namely, breaking and disintegration of the crust, can be prevented by applying a light surface treatment of tar or asphalt with the necessary covering material. Holes that have formed in the surface should be patched with one of the many patching mixtures; or, if only a shallow depression, with a "paint patch."

The third defect, namely, failure of the base, has but one remedy and that is to build up a thicker crust of metal. This may be done by building an additional retread top over the old one which is failing, after sufficient base metal has been added to secure the proper thickness.

Where Retread Top May Have Merit

We should not expect too much from any road with a weak base. This type of surface should not be built on a road with very little base metal where heavy trucking is part of the traffic. The thickness of base required will depend upon the amount of heavy trucking that will come on the highway.

This type has merit in surfacing old stone and gravel roads which have a heavy coarse of metal on them or roads which carry a heavy automobile traffic only during the summer season.

With the proper conditions of base and traffic, the type has its chief merit in that a smooth riding, dustless surface can be built at a very low cost compared with many types of pavement. The type is cheap in first cost because of the nature of the construction work which permits of dumping and spreading of the stone direct from a truck and also which permits the stone to be leveled with a grader or maintainer before the bituminous material is applied. These cheaper mechanical operations reduce the hand labor to a minimum which by taking advantage of the old metal in the base, whether this be gravel, stone or some other material, are the principal things which contribute to the low cost of this type of road.

Some one has criticised the type because it is not as good as one of the more expensive types of road. The same argument might be used against a Ford automobile because it is not as good as a Lincoln. Granting the latter statement to be true, this is no argument why we should stop using Ford automobiles. A lot of people can have a Ford car that cannot afford a Lincoln. The same thing is true with the cheaper types of road. Many people can have such a type that cannot afford the more expensive type. In buying a commodity, we must make the purchase fit the pocketbook.

However, we must not fool ourselves in thinking that a very thin crust of metal will carry heavy traffic in this climate where we have deep frost action and a rainy period which may come immediately after it thaws. This type has its limitations and they must be recognized. It would be more than wasteful to indiscriminately build it and thus place much of it where it is not appropriate.

4. Bituminous Macadam Top. This paper would not be complete without some further reference to the bituminous (penetration) macadam top. Inasmuch as it has been a standard type of road for many years, I shall refer to only a few features in its construction which may be comparatively new in standard practice.

Size of Coarse Aggregate

We have used for several years a size of coarse aggregate that would pass through a four-inch circular opening in a commercial screen, and that would be retained on a two and one-half inch opening. Where the aggregate is not one of the hardest limestones of the state, we prefer this smaller opening to be three inches and have permitted the upper size to be four and one-half inch.

Amount of Bitumen

In the past we have frequently used too much bitumen. In some of our best work this past year we used only about 1.8 gallons per square yard of heavy tar or asphalt and about 0.4 gallons of lighter material as a surface treatment where the thickness of coarse aggregate measured loose, was four and three-quarters inches. In some of our older roads we used entirely too much bitumen. Under heavy traffic they are inclined to show symptoms of forming waves and rolls on the surface.

The one way to prevent this is to keep the amount of bitumen to a minimum that will prevent raveling of the surface. I doubt whether anyone mistake has been so frequently made in constructing this type of road as the use of an excess of bitumen.

Black (Penetration Macadam) Base

A still further use of the bituminous macadam is as a base for rock asphalt or other bituminous mixture tops. For this base a standard penetration macadam top is built except that only about 1¼ gallon of bitumen is used per square yard and only enough covering stone to close up the large surface voids. The object sought is cement together the coarse aggregate so as to furnish the necessary bond to prevent raveling of the coarse stone under the hauling over it incident to the construction work, thus leaving a porous open surface to which the rock asphalt or other mixtures can well anchor itself. We have resurfaced about fourteen miles of old road this past year using this form of penetration macadam for a three-quarter inch rock asphalt wearing surface with very promising results.

EMPIRE STATE SAND AND GRAVEL PRODUCERS HOLD SECOND ANNUAL CONVENTION

THE Second Annual Convention of the Empire State Sand and Gravel Producers' Association, held at Rochester January 24, proved the most successful affair ever held by the association. Two sessions met in the Chamber of Commerce during the day and the closing session with a dinner convened at the Rochester Club in the evening.

Members and guests number nearly one hundred, and included David Noonan, Deputy Commissioner of State Highways, New York, Stephen B. Storey, City Manager of Rochester, Harold Baker, Commissioner of Public Works of Rochester, and Stanton Walker, Engineer of the National Sand and Gravel Association.

The association was organized at Syracuse, January 8, 1926, and now has an active membership of about thirty-five and is growing in numbers and interest. Firms selling machinery and equipment to the industry are admitted as associate members.

The business session was held at eleven in the morning. President G. K. Smith of Albany was unable to attend, due to illness, and John A. Taylor of the Valley Sand and Gravel Corporation was made chairman. In his report, Secretary-Treasurer John G. Carpenter enumerated a long list of activities, including the distribution of literature among architects, highway officials and cement products manufacturers, efforts to extend the use of number 1 gravel, enlisted co-operation of other associations in a movement for uniform inspection of aggregates by the state and enlisting the active aid of the chambers of commerce in various cities in the impending general freight rate revision. He stated that three meetings had been held during the year, seven bulletins had been distributed to producers; that he had visited about half of the plants in the state and assisted many producers in solving individual problems. As treasurer he reported that he had expended only about half of the income of the association.

The policy of the association on several lines of activity was discussed and referred to the executive committee. There was an inclination to limit membership to producers who expressed an active interest in the association and maintained a high standard of production. The following officers were elected: President, David Hyman, of the Buffalo Gravel Corporation; Vice President, Henry F. Marsh, of the Consolidated Materials Corporation, and Secretary-Treasurer, John G. Carpenter, of Madison Sand and Gravel Corporation. The executive committee will comprise the above officers and two others to be appointed by the president.

The afternoon session opened with a luncheon given by the Valley Sand and Gravel Corporation and the Consolidated Materials Corporation, and in the absence of the president the program which followed was in charge of Secretary-Treasurer, John G. Carpenter.

"Dredging Bank Gravel," by H. A. Stalley, of the Buffalo Gravel Corporation. Mr. Stalley illustrated the subject by describing a dredging plant which he built for the Valley Sand and Gravel Corporation in 1926 near Rochester and heartily recommended the method where conditions are favorable.

"The Clarence Rate Case," by E. W. Gumaer, attorney, Rochester, stated that in the winter of 1927 the West Shore Railroad published a rate of 40 cents per ton on sand and gravel from Clarence to Buffalo, a distance of about 16 miles, when the lowest other rates into Buffalo were 65 cents. Mr. Gumaer represented one of the competing roads on the hearing and he explained the case and stated that a decision was expected soon.

"Uniform State Inspection of Aggregates," by John C. Carpenter, explained the systems of inspection in use in several other states and stated that as chairman of the association committee he was trying, with apparent success, to secure the co-operation of the New York State Crushed Stone Association and the New York Highway Chapter in suggesting a tentative plan to the New York Highway Department, and that Commissioner Brandt has already been interviewed. He expressed the view that a simple and conservative plan would soon be concluded and submitted.

"Uniform Freight Rates on a Mileage Basis," by F. W. Burton, Manager of the Transportation Bureau of Rochester Chamber of Commerce, pointed out the wide variance in mileage tariffs now in force and predicted a general revision in the near future. He promised active aid to the sand and gravel interests when the break occurs.

"The Demand for Superhighways," by Hon. David Noonan, Deputy Commissioner of Highways, New York, was a complete exposition of the road problems of the Empire State and how the Department was meeting them. He used an unpublished work map of the main arteries of traffic to illustrate his points. The main trunk lines contemplated for the next decade include concrete roads on either side of the Hudson River from New York to Albany, one of them leading from Albany to Buffalo through rural districts in nearly a straight line and the other running north through Utica, Syracuse and Rochester to Buffalo. These roads will have a minimum width of 27 feet and in congested districts will have a width of from 40 to 60 feet as the traffic demands. Other short superhighways will extend from Niagara Falls toward

Erie, Pennsylvania, through Long Island, from Albany north and from New York toward Connecticut.

At this point, Mr. Carpenter called upon J. O. Bowker, of the Birnie Sand and Gravel Company, Springfield, Mass., as the long distance traveler of the convention. He expressed his pleasure in the opportunity to attend and complimented the association on its activity and interest.

"Quality of Aggregates and the National Association," by Stanton Walker, Director of Research of the National Sand and Gravel Association, explained the importance of quality aggregates and how the National Association is promoting their production and use. Mr. Walker pointed out the value of engineering service and gave examples of the service of this kind that had been rendered. An interesting feature of his appearance was the general discussion of questions asked by members.

A visit to the Rochester Automobile Show at Exposition Park by many of the visitors completed the afternoon's program.

The dinner held at the Rochester Club at 6:30 p. m. was attended by practically all the visitors and proved a most enjoyable and instructive affair. John G. Carpenter presided and at the speakers' table were Stephen B. Storey, Harold Baker, Henry L. Howe, Jr., Stanton Walker, George E. Schaefer and J. F. Ancona. On account of the sickness and transfers to the afternoon program, the formal addresses of the evening were reduced to three, but these were supplemented by short and snappy talks by City Manager Storey and Commissioner of Public Works Baker. Letters of regret from Hon. Arthur W. Brandt, Commissioner of Highways of New York, Senator Charles D. Newton, former attorney general of New York, Hon. H. S. Sisson, former state commissioner of highways, and Hon. Charles Cadle, former state engineer, were read, in which each promised to attend the next convention.

"Aggregates in City Construction" was presented by Henry L. Howe, Jr., City Engineer of Rochester. He outlined the growth of the demand for better aggregates, explained the work of the city research laboratory and stated that the city is always alert to secure the best aggregates available.

"Our Common Interests" were discussed by George E. Schaefer, of the General Crushed Stone Corporation and president of the New York Crushed Stone Association. He brought a message of good will from the crushed stone producers and mentioned uniform state inspection, freight rates, cleaning and repairing cars, maintenance of quality of aggregates and honorable competition as problems subject to joint action of the associations. He expressed the hope that the spirit of friendly co-operation that had just begun between the associations would continue with ever increasing interest.

"Research and Specification Problems of Sand and Gravel Producers" were explained by Stanton Walker, engineer of the National Association. He stated that many of them were of technical nature and required the service of an engineer. He explained how the national association is solving these problems and cited the work in securing standardized specifications and similar activities. He advised the producers to keep in touch with research agencies and explained to them how reports of research work could be procured. For a moment he yielded the floor to George E. Schaefer, who stated that the funds for a research laboratory for the National Crushed Stone Association were assured, and earnestly urged that Sand and Gravel producers get behind their movement for a research laboratory.

National Forest Road Funds Set

A total of 31 states and two territories will receive an aggregate of $7,500,000 for the construction of forest highways within the national forests of the country, according to apportionment of Federal forest road funds, just announced by the Department of Agriculture. Three states, viz., Idaho, California and Oregon, will receive more than $1,000,000 under the apportionment, receiving the largest sums, of course, because of their extensive national forests.

Under the apportionment of the federal funds, $4,500,000 is to be expended in the construction and improvement of automobile highways in and adjacent to the national forest, and $3,000,000 is to be used in the construction and maintenance of roads required mainly for the development and protection of the forests.

The apportionment to the states and territories having national forests is as follows:

Alabama	$ 16,146	New Mexico..	$ 329,498
Arkansas	79,378	Oregon	1,074,899
Florida	35,524	S. Carolina...	7,496
Illinois	383	Utah	218,893
Michigan	5,078	W. Virginia ..	26,641
Nebraska	5,775	Arizona	421,255
New Jersey ..	1,231	Colorado	477,063
Oklahoma ...	2,410	Idaho	1,151,800
Porto Rico ...	772	Maine	8,010
Tennessee ...	42,006	Montana	680,151
Washington ..	633,879	New Hampsh.	39,722
Alaska	490,844	N. Carolina...	47,212
California ...	1,113,155	Pennsylvania.	13,100
Georgia	26,217	S. Dakota	58,805
Kentucky	3,663	Virginia	42,539
Minnesota ...	60,648	Wyoming	287,764
Nevada	98,038	Grand total...	$7,500,000

1927 INCOME TAX RETURNS OF PARTNERSHIPS

A PARTNERSHIP is an association of two or more persons for the purpose of carrying on a business together and dividing the profits. A partnership is not necessarily formed when two or more persons engage in a joint venture for profit nor does the joint ownership of real estate and the dividing of the net income from rentals for instance constitute a partnership while the intent of the parties is an important factor in determining whether a partnership actually exists or not, when they engage in a regular business by agreement either oral or written providing for a division of the profits, a partnership will be presumed to exist.

The income tax law provides that every partnership shall file with the collector of Internal Revenue for the district in which its principal office is located, an annual return on Form 1065 of its income regardless of the amount of net income. If the partnership keeps its books on the basis of a fiscal year other than the calendar year, it must render a return on such fiscal year basis regardless of the annual accounting period of the members of the partnership.

The income tax law does not recognize partnerships as a taxable entity and, therefore, imposes no tax directly upon such incomes. The return is for the purpose of accounting to the Government for the net income of the partnership and the portion thereof which must be reported on the individual return of each member for taxation. The return must be sworn to and signed by one of the partners.

Gross Income

Generally considered, gross income for tax purposes which includes the following:

1. Business income.
2. Interest on bank deposits, notes, mortgages and corporate bonds.
3. Income from other partnerships.
4. Profits from sales of and dealings in property.
5. Income from investments in property or securities, such as rent and interest.
6. Dividends from stocks. (Stock dividends however are not taxable.)
7. Gains, profits, and income derived from any source whatever, unless exempt from tax by law.
8. Profits derived from sales in foreign commerce.

Gross income for tax purposes does not include the following items, which are exempt from taxation:

1. The proceeds of life insurance policies paid upon the death of a partner to remaining partners.

2. Interest upon—(a) the obligation of a state, territory, or any political subdivision thereof, or the District of Columbia.

(a) Securities issued under the provisions of the Federal Farm Loan Act of July 17, 1916, or under the provisions of such act as amended.

(b) The obligations of the United States or its obligations.

(c) Bonds issued by the War Finance Corporation.

But statements as to the income derived from the above and the amounts of securities held, must be submitted. Interest on United States Government obligations is exempt to the extent provided in the various acts creating the obligations; but interest on liberty bonds is exempt from all normal tax.

Deductions From Income

All interest paid or accrued (not including interest deducted from gross income in computing income from business) within the taxable year on indebtedness may be deducted from gross income.

Losses by fire, storm, etc.—Losses sustained during the taxable years and not compensated for by insurance or otherwise are fully deductible if insured in the following manner:

(1) By a tax payer's trade or business.

(2) In any transaction entered in for profit.

(3) If arising from fire, theft or other casualty.

In determining the losses incurred through sale of property, proper adjustments must be made in each case for expenditures properly chargeable to capital accounts, and for items of loss, depreciation, obsolescence, amortization, or depletion, previously allowed with respect to the property. Moreover, the amount of loss must be reduced by the amount of any insurance or other compensation received, and by the salvage value, if any, of the property. It is assumed that the "salvage value" represents that portion of the value of the property which may have actually been or is estimated will be realized from the disposition of the damaged property. Losses arising out of voluntary demolition of old buildings or scrapping of old machinery, etc.

It is possible to claim a loss from property in cases where business conditions or legislation makes the further use of the property unprofitable so that a discontinuance of the business or an actual abandonment of the assets become necessary. The loss in such case is a loss of useful value and is computed in the same way as a loss resulting from a sale. This loss, however, cannot be claimed in connection with inventories and, in

fact, can only be applied to capital assets. Mere shrinkage in the value of stocks because of business or market conditions is not a deductible loss until actually realized through sale or other disposition of the stocks.

In this connection, it may be noted that many business men owning stocks and securities, have made it a pactice in the past, to sell their holdings which had shrunk in value at or near the end of a taxable year in order to claim a loss. Then early the next year after thirty days, they repurchase the same securities at the decreased value thus coming into possession again of the securities sold during the previous year. It must be noted here that the income tax law provides that no loss can be claimed on the sale of securities, where it appears that within thirty days before or after date of sale or other disposition, the taxpayer has acquired substantially identical property and the property so acquired is held by the taxpayer for any period after such sale. However, such transactions and losses are recognized as legitimate when made in the ordinary course of business.

Bad Debts

The income tax law provides that bad debts may be treated in either of two ways: (1) by a deduction from income of the total amount of debts found to be worthless or (2) by a deduction from income of an addition to a reserve for debts. A reserve for bad debts usually is a percentage of the year's sales set aside to take care of bad debts. This percentage is usually based on past experiences, noting how many bad debts there have been and dividing by the sales, thus arriving on the percentage to be used.

Any amounts which are collected after a debt has been charged off as uncollectible must however be reported as income for the taxable year in which it is received. The proceeds obtained from any collateral securing the bad debts which was considered as valueless when the bad debt was written off, must also be returned as income during the taxable period it is received. Deductions made for parts of debts cannot be figured as a percentage of all debts, but must in reference to specific debts only.

The following method will keep in determining the worthlessness of debts.

1. When the circumstances about a debt indicate that it cannot be collected and when it is apparent that legal action and judgment will not yield anything, the debt may be considered worthless. If, however, a portion of the debt is collected, then the portion remaining uncollected is considered as a bad debt. Legal expenses incurred in the collecting of part or all of a bad debt may be deducted as a business expense.

2. When a debtor becomes bankrupt, part or all of the debt usually becomes worthless, especially if there is no collateral or surity behind the debt. Often it happens that it is difficult to determine just what part of the debt is worthless until the settlement in bankruptcy takes place. However, in such case, it is the correct procedure and the wisest to charge off the full debt as worthless during the current taxable year. The reason for this is of the settlement of the bankrupt is made within the next year or two, the dividend received will be treated as income in the taxable period received. As the tax rates on individuals are being reduced almost each year, it means that each partner will save by having a probable lower rate to pay on his income.

Where mortgaged or pledged property is lawfully sold, whether to the creditor or other purchaser, for less than the debt and it is ascertained by the mortgagee or pledgee that the remainder of the debt is wholly or partially uncollectible, and this remainder is charged off, such uncollectible portion is a deduction for the taxable period when the worthlessness has been established and the amounts charged off. Where a taxpayer buys in mortgaged or pledged property for the amount of the debt, no deduction shall be allowed for any part of the debt, gain or loss in such event is realized when the property bought in, is sold or disposed of.

No deductions can be taken for bad debts that are the result of fluctuations in securities that are owned by the partnership. The losses in such cases are allowed only when the securities are sold or otherwise disposed of. However, if the partnership holds securities of a corporation which become worthless, the loss may be deducted as a bad debt.

If the reserve for bad debts' method is used, it is necessary to show in filing the income tax return the volume of the year's credit sales and the percentage of the reserve established to such volume, he must also show the total amount of notes and accounts receivable at the beginning and the end of the taxable year and the amount of debts which were definitely ascertained as worthless during the taxable year and charged to the reserve.

Distribution of Income

As the income tax law requires the partnership to be distributed to the members of the partnership, it is necessary that each member's portion be subdivided into the classes of income taxable at different rates on his individual return.

The partnership return must therefore show in the distribution section the following:

1. Name and address of each partner. This is for the purpose of tracing the income to the partners' individual returns.

2. Interest of each in the partnership. This refers to the proportionate interest in the income

rather than in the assets; in other words it refers to the profit-sharing ratio rather than the capital ratio.

3. The division of capital net gain, if any, meaning the gain derived from the sale of capital assets held for investment capital net losses should also be reported.

4. The division of income from dividends on stock of domestic corporations or of foreign corporations which derive 50 per cent or more of their income from sources within the United States.

5. The distributive shares of other income consisting principally of business operating profits.

6. The amount of income and profit taxes, if any, paid to a foreign country or to a possession of the United States.

A partner's share of each of the above mentioned items is merged with similar personal items, if any, and reported on his personal return.

Form 1040 in the Proper Columns

Each partner is subject to tax upon his entire distributive share of the partnership net income even though he may not have actually received it from the partnership.

In addition to filing a partnership return, the income tax law requires in addition the filing of forms 1099, 1096 and 1126.

Form 1099 is for the purpose of furnishing information of the names of all employees to whom payments of $1,500 for a year are made. Employees who are married are not required unless paid more than $3,500 per year.

Form 1096 is a summary of the total of amounts and number of reports made on forms 1099.

Form 1126 is for the purpose of recording the inventory at the end of the taxable period. The tax law provides two tests to which each inventory must conform. (1) It must conform as nearly as may be the best accounting practice in the trade or business, and (2) it must clearly reflect the income.

The basis of valuation most commonly used by most business concerns and which meets the requirements by the income tax statutes is (a) cost or (b) cost or market, whichever is lower. Any goods in an inventory which are unsalable at normal prices or unusable in the normal way because of damage imperfections, shop wear, or other similar causes, should be valued at bona fide selling prices less cost of selling whether basis (a) or (b) is used. If such goods consist of raw materials or partly finished goods held for use or consumption, they should be valued upon a reasonable basis, taking into consideration the usability and the condition of the goods, but in no case shall such value be less than scrap value. Bona fide selling price means actual offering of goods during a period ending not later than 30 days after inventory date. The burden of proof rests upon the partners to show the such exception goods as are valued upon such selling basis come within the classifications indicated above, and he is required to maintain such records of the disposition of the goods as will enable a verification of the inventory to be made.

Goods taken in the inventory which have been so intermingled that they cannot be identified with specific invoices will be deemed to be either (a) the goods most recently purchased or produced, and the cost thereof will be the actual cost of the goods purchased or produced during the period in which the quantity of goods in the inventory has been acquired, or (b) where book inventories are maintained in accordance with a sound accounting system in which the respective inventory accounts are charged with the actual cost of the goods purchased and credited with the value of the goods used, transferred or sold, calculated upon the basis of the actual cost of the goods acquired during the taxable period (including the inventory at the beginning of the year) the net value as shown by such inventory accounts will be deemed to be the cost of the goods on hand. The balance shown by such book inventories should be verified by physical inventories at reasonable intervals and adjusted to conform therewith.

The inventories should be recorded in a legible manner, properly computed and summarized, and should be reserved as a part of the accounting records.

The following methods, among others, sometimes used in taking or valuing inventories; have been ruled not to be permissible, viz:

(1) Deducting from the inventory a reserve for price changes, or an estimated depreciation in the value thereof.

(2) Taking work in process, or other parts of the inventory at a nominal price or at less than its proper value.

(3) Omitting portions of the stock on hand.

(4) Using a constant price or nominal value for a so-called normal quantity of materials or goods in stock.

(5) Including stock in transit, either shipped to or from the taxpayer, the title of which is not vested in the taxpayer.

After filling out all the forms mentioned above, each one with the exception of form 1099 (reporting individual salaries) must be acknowledged by and sworn to before a notary public by a least one partner in the partnership and mailed to the proper destination which is the Federal Income office in that district.

THE BUREAU OF ENGINEERING AND SALES

By A. T. Goldbeck, Director, Bureau of Engineering, N. C. S. A.*

THE relation which the Bureau of Engineering bears to the sale of crushed stone in some ways is very tangible and in others of a very intangible but none the less positive value.

It is an undoubted fact that literature describing the best use of crushed stone is of advertising value and helps to induce the greater use of stone. The Bulletin prepared by the Bureau of Engineering on, "Low Cost Improvement of Earth Roads with Crushed Stone," is an illustration of literature of this type and soon another Bulletin will be issued on, "Retreading Our Highways," closely following the Journal article on this subject. A rather elaborate bulletin is also ready for publication on the Bituminous Macadam type of road which likewise should be of considerable advertising value for stone. Direct information of this sort in the hands of salesmen and sent out by the various companies is the most valuable form of advertising literature and an effort has been made to place the best and most accurate information available in these bulletins for the use of engineers.

Of more intangible value were the bulletins, "The Bulking of Sand and Its Effect on Concrete" and "The Water-Ratio Specification for Concrete and Its Limitations." Off-hand, one might think that such subjects as these have a very remote connection with the sale of stone but let me do a little explaining which may help to clear up the reason for these bulletins and may also help to explain how they should help stone sales.

First, with respect to the bulking of sand, complaint is sometimes heard from contractors that stone concrete is harsh working. This is often due to the lack of sand in the mixture as well as to the use of coarse aggregate which has become segregated and lacking in fine particles. The contractor is apt to blame such harshness entirely on the angularity of the coarse aggregate, whereas, the basic difficulty is in the concrete proportions. Most concrete is still proportioned by volume and the same proportions are used irrespective of the voids and other characteristics of the coarse aggregates. Under this system, which cannot be too strongly condemned, stone concrete makes a worse impression on the contractor than gravel concrete because the gravel concrete is more apt to have sufficient fine material in the mix than stone concrete. Any variation in the volume of the sand will make for, now a lack, now an abundance of sand. When there is a lack the concrete is non-workable. The proportioning of the concrete on the basis of dry sand will insure that there will be a constant amount of fine material in the mix and much, though not all, of the difficulty due to lack of workability or variable workability will disappear. Recognition of the principle of the bulking of sand is, therefore, important to the stone producer because it helps to dispel the stigma of harshness of mix from stone concrete.

The water-ratio bulletin explains the limitations of the water-ratio theory. This theory has worked harm to stone producers because the contractor is required to keep a constant ratio of volume of cement to volume of water in the mix. Stone concrete requires more water than gravel concrete to produce like workability and, hence, the contractor must use more cement in stone concrete than in gravel concrete. This requirement of the water-ratio specification ignores the fact that stone concrete may give as high strength as that made with other aggregates even though it may require more water in the mix. It is important to point out this fact to the users of concrete and it should be continued to be pointed out until the limitations of the water-ratio theory are just as well known as the theory itself.

There are various kinds of research which have been urged by the Bureau of Engineering having to do with the competition of aggregates. Tests carried out by one of the member companies at the suggestion and with the assistance of the Bureau show some startling results with regard to the effect of the coarse aggregate on the transverse strength of concrete. For instance, it is shown that higher results in cross-bending were obtained with a particular stone concrete with six bags of cement per yard than with the gravel with which it was in competition containing 6.3 bags per cubic yard, and much higher than with a still inferior grade of gravel containing seven bags per cubic yard. The full results no doubt will be made available to you shortly. I leave it to you salesmen if results such as these will not help you to sell stone, particularly when they are recognized by a suitable change in specifications. At present it is actually the case that more cement is required per cubic yard for stone concrete than for gravel concrete, yet the test results show that, with these particular materials, this situation should be reversed. I haven't much doubt that similar relations will be found to hold in different sections of the country where other aggregates are concerned. The influence which the Bureau of Engineering has on the writing of proper national specifications for aggregates and for concrete is also of great assistance to sales even though this may not be at all apparent to many of you.

*Presented before the National Crushed Stone Association, January 17, 1928.

VALUE OF FINANCIAL AND OPERATING RATIOS IN BUSINESS MANAGEMENT

By J. J. Berliner

IN EVERY branch of industry there are certain characteristic financial and operating ratios, depending upon the nature of its activities. A practical way of determining these is by averaging the ratios of the individual competing concerns within the industry. These are the standard ratios which each of the competing concerns must approximate if it is to enjoy the average measure of success. Comparison with them constitutes a check on the concern's managerial efficiency, enabling it to see wherein it is ahead and wherein it is behind its competitors in the field.

The major objects sought in the preparation of this article are to emphasize the importance of the understanding and use of financial statistics in the conduct of business activities and to illustrate methods of reading, analyzing, and interpreting financial statistics in a manner to derive more than the usual amount of information and value out of them. When it is fully appreciated that well-analyzed financial statistics afford the best basis for judging the affairs of a company, from both the internal and external point of view, more attention will be given the preparation and use of such statistics in business.

Use of Financial Statistics Within a Business

The financial statistics used within business organizations may be divided into three general classes:

1. Statistics on a business for use in directing and controlling its operations and financial affairs.
2. Statistics on the industry, developing competitive standards in that line of business to which earnings and expense ratios, turnovers, and other statistics of the individual company may be compared, thus indicating the status of the individual concern in relation to its competitive standards.
3. Statistics on the activities of customers to whom credit is extended, as the company is vitally interested in the affairs of its customers who, in the aggregate, represent its outlet for products.

In addition to statistics on the individual business, provision should be made for accumulating all available statistics on the activities of the particular industry. By comparing the showing of the individual company to these standards or averages, most valuable and useful information may be obtained. In most lines of business, quite usable statistics on the affairs of the industry can be developed from published financial statements and reports received from commercial agencies or other available data.

Most business men are very much interested in the results shown by competitors and natuarally compare their own accomplishments with those of others. What they need is an analysis of the reasons why their showing may compare favorably with that of other business. The more complete the information available on the activities of other concerns, the better and more useful the analysis which may be made. But even with incomplete reports, valuable information may be developed by comparisons with the statistics of one's own concern.

Financial and Operating Ratios as Measures of Efficiency

The more important measures of efficiency which may be applied to practically all business, include measures of earnings, measures of costs and expenses, turnovers, and other financial relationships. Summarized, these are as follows:

Measures of Earnings

The relation of surplus net profits to net worth.

The relation of surplus net profits to volume of business.

The earnings on common stockholders' investments (if a corporation).

The relation of operating profits to total capital used.

The relation of operating profits to volume of business.

The relation of gross earnings to volume of business.

Measures of Costs and Expenses:

The relation of costs and expenses to volume of business.

The relation of property expenses to investment and sales.

The cost of borrowed capital.

The cost of total capital employed.

Turnovers:

The turnover of total capital employed.

The turnover of inventories.

The turnover of accounts receivable.

The turnover of fixed property investment.

Financial Relationships:

The working capital ratio.

The manner in which capital is invested.

The sources from which capital is secured.

The proportion of earnings left in the business.

In addition to the foregoing, there are other important measures of efficiency, applicable to most industrial business, among which should be mentioned:

Measures of labor efficiency, such as the output per man per hour.

Measures of machine or operation efficiency.

The relationship of non-operating income and expenses.

The income earned on non-operating investments, both gross and net.

The income earned on non-operating investments, both gross and net.

The income received from investments and securities in relation to the amount of capital tied up.

In making an analysis of the activities of any business, it is the relationships which should be studied. These measures of business efficiency should be thought of as the yard-stick by which to judge the status of the business. They should enable business executives to judge whether the conditions meet satisfactory and profitable standards.

Business should normally be profitable, and there are more or less normal relationships which must exist within a business if it is to be profitable. Costs and expenses must be in proportion to sales. The volume of business done must bear a satisfactory relationship to the investment used. The margin of profit realized should meet competitive standards. These are basic relationships within a business which are to be judged by the above measures of business efficiency.

When a business is unprofitable, it means that some of the basic relationships are out of order. The difficulty may be in the lack of sufficient gross margin, or in too high expenses, yielding unsatisfactory operating results, or in poor turnovers, cutting down the return on the investment, or in various other causes.

Research into many hundreds of insolvent companies indicate that there are five common business ailments which are usually the result of managerial inefficiency to some degree.

One or more of the five are found to exist in the case of practically every honest failure.

These five common business ailments are:

1. Insufficient net profits.
2. Over-investment in inventory.
3. Over-investment in receivables.
4. Over-investment in fixed assets.
5. Insufficient capitalization.

Unfavorable Relationships Indicate Need of Executive Action

Financial and operating statistics indicate both the status of the basic relationships in the business and the executive action needed to correct unfavorable conditions. For example, an unfavorable gross margin directs attention at once to the merchandising transactions, the prices at which goods are bought and sold. Unfavorable net operating results may be due to both. In any event, attention is directed either to the unfavorable margin or the particular expenses which are out of line.

Poor turnovers of inventories direct action to the movement of certain surplus stocks. Turnovers should be figured in detail on the inventories in the several departments or units of the business, in order to center attention to the collection methods and business conditions affecting the trade, etc. A poor turnover on plant investment should restrict further expenditures for plant and equipment, and calls attention to the necessity for getting volume. Unfavorable surplus net results may be due to any of the foregoing, or to excessive interest and non-operating expenses. It is by analysis that one determines the causes for any unfavorable showing.

These measures of business efficiency should be thought of as indicators which express the conditions in a business and point out the sore spots needing attention. When these are once determined, the executive action needed is obvious in most cases.

Relation of Surplus Net Profits to Net Worth: The relations of surplus net profits to net worth is final summing up of all other relationships and measures of business efficiency. It results from, and includes, all other relationships, earnings and expense ratios, turnovers, etc. Favorable or unfavorable gross margins, expenses, operating earnings, turnovers, etc., are all included in and affect the final net return. It is, in the last analysis, the measure of commercial success obtained in the management of the affairs of a business in all three management functions—merchandising, operating, and financial.

Methods of Computing: The net worth is the difference between all the assets and all the liabilities. It represents the owners' or stockholders' equity in the business.

The surplus net profits are the final balance of profits remaining, after caring for all costs, expenses, interest, taxes, and extraordinary losses.

The relation of the surplus net profits to the net worth should be stated as the percentage earned per year on the net worth at the beginning of the year. For periods of less than a year it is advisable that the percentage stated should be reduced to a yearly basis, that is, stated as percentage of return earned per year, in order that monthly or periodical figures may be readily compared to yearly standards.

Differences in Return Earned by Various Industries

In competitive lines the return earned on the investment tends to be about a fair average return for the use of capital. Substantial differences in returns earned by various industries, competitive conditions, the character of the business done, and the risks involved.

Statistics on a large number of representative companies in different industries show an average return of 8½% per year, with unusually large returns as well as the post-war years, with subnormal returns. The average also includes some industries favorably affected by the war-time conditions and others less favorably affected. The difference in earnings as between different industries may be largely accounted for by business conditions affecting those industries and by the competitive conditions existing within each industry.

Relation of surplus net profits to the volume of business is the measure of profit on turnover as distinguished from the relation of surplus of net profits to net worth, which is the measure of return earned on investment. The surplus net profits of a business should be considered as related to both the net worth and the volume of business done. The one measure expresses the return on the investment, the other the margin of profit on the volume which produced that return.

The relation of surplus net profits to volume of business should always be figured as a percentage on sales and, in addition, wherever possible, it should be computed in relation to the physical volume of business done; that is the amount of surplus net profits realized per hundredweight, per ton, per gallon, per case, or other unit of physical volume. On this basis the unit surplus net profits may be considered in connection with unit costs, unit expenses, and unit prices, which are usually thought of as an amount per hundredweight, per case, etc.

The sales upon which the percentage is figured should be the net sales for the period, after making deductions for the returns, allowances, freight, etc. The physical volume upon which the unit surplus net profits might be figured should be the net volume of goods sold after allowing the returns.

While the percentage of surplus net profits earned on sales should be considered as related to and complementary to the percentage of surplus net profits earned on net worth, the two should not be confused. Nor should the percentage of profit a business earns on its sales be considered in itself a sound measure for judging whether or not such profits were adequate. The real measure of the earning power of a business, or of any department or portion of a business, is the net profits which it earns on the investment employed. The margin on sales required to yield any desired return on the investment is quite a different figure, and will depend entirely upon the rapidity of the turnover of capital in the business. A high return on sales does not in itself indicate a large return on the investment, nor on the contrary does a narrow margin on sales indicate a small return on the investment. It is all a matter of the rapidity of the turnover of capital used in the business, that is, the relation of the volume of business done to the capital employed.

For instance, if a business does a volume of $100,000 per year and employs a total capital of $100,000, in order to realize a return on the investment of 10%, it must earn net a margin of 10% on the sales. If the same volume of business is handled by another concern on one-half of the amount of capital, it can realize the same return on the investment with but one-half of that margin on sales.

The rapidity of turnover of total capital varies widely in different industries, due to differences in the types of business. Consequently, the margin of surplus net profit on sales necessary to yield an average return on the investment, also varies widely. The following table illustrates this point as well as showing the wide differences in the margins earned on sales in different industries.

	Average for Period of Years	
	% Earned on Sales	% Earned on Net Worth
American Beet Sugar Co.	15.8	7.5
American Locomotive	10.3	10.0
American Tobacco Co.	13.5	10.9
Anaconda Copper Co.	15.2	9.8
Armour & Co.	1.2	5.1
Central Leather Co.	4.7	4.4
General Electric Co.	10.9	13.1
General Motor Co.	6.4	10.5
May Department Stores	7.5	10.0
Pittsburgh Coal Co.	17.2	6.5
Sears, Roebuck & Co.	6.4	11.3
Swift & Co.	1.7	8.6
Texas Oil Co.	21.9	15.8
United States Rubber Co.	6.7	7.3
United States Steel Co.	10.7	9.2
Woolworth Co.	8.4	12.0

Relation of operating profit to total capital employed: From the operating point of view, the real measure of the financial return earned by a business is the percentage of operating profits earned on the total used in the conduct of such operations. This is the measure of the earning power of the operations of a business on the capital used therein, regardless from what source such capital may have been secured. In judging the operations and transactions of a business, the most important considerations include the amount of capital used and the profits resulting from the operations conducted. The percentage of operating profits earned on capital employed states concisely the relationship in question.

As this is a measure of the financial return earned by the operations of a business on the capital used, it may and should be applied to the several departments or units which compose a business. The investment used in different departments, plants or operations should be allocated to

such departments or units, and the net results produced by each one considered in connection with such investments. This is a measure of financial return which may be applied to all types of operations. It is the one common measure of commercial success which may be applied to any kind of business. The capital invested by an organization in its several departments or units should place responsibilities upon each of these units for the earning of a fair return on such capital used.

The relation of the operating profits to the total capital employed should be stated as the percentage of operating profits earned annually on the average capital used in the conduct of such operations and transactions. Where computations are made for periods of less than one year, the percentage stated should be reduced to a yearly basis. That is, operating earnings for a month or other period should be stated as the per cent per annum, in order that comparisons may be readily made on a common basis with annual standards.

Turnover of Total Capital Used

The turnover of total capital used expresses the relation of the volume of business done to the total capital employed. It is a measure of the efficiency in the use of capital in a business—a measure of the effectiveness of the financial management. The larger the volume of business done on a given investment, or the smaller the amount the capital used to handle a given volume of business, the more favorable the return on the investment produced by the margin of profit earned on sales.

The turnover of total capital is a general measure, as it includes and summarizes the turnovers of inventories, accounts receivable, and on plant investment. A favorable turnover of total capital used may be the result of favorable showings in all of these subordinate turnovers, or of favorable results in some and unfavorable results in others.

The turnover of total capital used is the connecting link between the (1) per cent of operating profits on sales and (2) the per cent of operating profits earned on total capital used.

The amount of operating profits is definitely related to sales and to the investment used. The turnover of total capital expresses the relationship which must exist between these two ratios of earnings. For example, a concern having a turnover of 3 times per year and averaging 6% margin on sales will realize an operating profit of 18% on its total used. If the turnover is 4 times per year the same margin of 6% will yield a return of 24% on the total investment used.

The advantages of a better turnover of total capital is translated directly into terms of additional profit realized on net worth. Competitive conditions quite definitely limit the amount of operating profits a business may realize on its sales. Naturally the smaller the capital used in the conduct of a business, the larger return on the investment such operating profits will be.

Turnover of Inventories

The turnover of inventories measures the rapidity with which stocks of goods are sold out and replenished. The more rapidly the investment in inventories is turned over, the smaller the amount of capital required to do a given volume of business. On each turnover of an inventory a margin of profit is realized and discounts are earned. The more rapidly this inventory investment may be turned over the more times per year the inventories are sold out, the larger is the return on the investment used.

Computing Inventory Turnover

The proper method of computing a general turnover of inventories is to divide the average annual inventory (average monthly) into the cost of sales for the year. This indicates the times per year that the average amount of capital tied up in inventories has been sold out and re-invested in new stocks. This is the method to be used in figuring the inventory turnover of the business as a whole. However, some other points need to be considered in computing turnovers in certain lines of business and in different classes of inventories. In analyzing financial reports, when complete statistics are not available, a fair measure of turnover may be obtained by dividing the closing inventory into the sales. This measure indicates the dollars of sales per year, per dollar of inventory at the end of the year.

There are few organizations that fully appreciate what it costs them to carry stocks and few compute carefully enough the definite advantages they would have in a more rapid inventory turnover or figure the disadvantage imposed upon their business by a turnover slower than average or normal. In every line of business there is a normal period of turnover within which stocks and goods should be converted into sales. To carry products beyond that period means added financial costs and carrying expenses which must come directly out of profits. In this manner subnormal turnovers mean forfeited profits. The added costs incurred in carrying goods beyond the normal turnover period may be quite readily computed either in percentage on sales or in unit costs on physical volume.

Turnover of Accounts Receivable

The turnover of accounts receivable expresses the relationship between the volume of business done and the amount of accounts receivable outstanding and unpaid at the close of the period. This is a measure of the economy observed in the use of capital tied up in receivables.

A business has to pay someone for the use of

capital which it has invested in its accounts receivable. The use of this capital, on the other hand, is extended free to the customers. Consequently, the cost of such capital to the business must come out of the margin of profit made on sales. The margin of profit on a sales transaction is limited at the time the sale is made. The longer the account is carried, the smaller the return realized on the investment, the heavier the collection expenses, and the greater the possibility of loss through bad debts.

Manner of Computing Turnover of Accounts Receivable

The turnover of accounts receivable is most effectively stated in the number of average days' sales represented in outstanding accounts receivable. It is figured by dividing the amount of average daily sales into the average amount of accounts receivable. For example:

If the average receivables are....$50,000
and the average daily sales are.. 1,000
the turnover should be stated as..50 days.

The turnover of acounts receivable may also be stated as the dollars of annual sales per dollar of accounts receivable outstanding. This is computed by dividing the amount of receivables into the amount of annual sales.

The advantages of a more rapid turnover of accounts receivable may be translated directly into terms of added surplus net profits on the investment. For instance:

Assume that a business is doing an average daily sales volume of	$ 2,000
and carries average accounts receivable of	100,000
this sum is the amount of average daily business done in....	50 days
If the turnover of receivables can be improved to show outstanding accounts receivables of	30 days
of average sales, and if the capital thus released is used in reducing liabilities, it will bring the total amounts of accounts receivable down to.....	$ 60,000
and this would mean a saving in interest on borrowed capital, figured at 6%, of..... per year.	24,000

Turnover on Fixed Property Investment

The turnover on fixed property investment expresses the relationship of the volume of business done to the capital tied up in plant and equipment. This is one of the fundamental relationships of a business and deserves much more consideration than it has received. The property expense burdens, such as depreciation, insurance, taxes, interest, etc., are dependent upon the amount of property investments and may represent favorable or unfavorable unit costs on the sales volume of business done, depending on the turnover—the volume of business handled on the fixed property investment.

Obviously more favorable costs are obtained when a plant is operating at about capacity than is possible with a volume of 60% to 70% of capacity. Business men generally recognize the advantages a concern has in operating its plant and equipment to capacity and fully appreciate the disadvantages of heavier unit fixed expenses that occur when volume is substantially less than capacity.

Computing Turnover: The turnover on fixed proper investment may be computed on either or both of the following basis:

1. The relation of sales to the property investment, expressed as the dollars of annual sales per dollar of fixed property investment; or
2. The units of physical volume per year, per dollar of fixed property investment, usually stated as the pounds, cases, gallons, or other units shipped or handled per year, per dollar of property investment.

The advantages of a favorable turnover on fixed property investment and the disadvantages of an unfavorable one deserve a great deal of thought and consideration. The business organization which enjoys a good turnover on fixed property investment is in a fortunate position in meeting competition, and by conservative policies may maintain quite permanent advantages over others less fortunately situated in this respect.

Working Capital Ratio

The working capital ratio, or relation of current assets to current liabilities, is probably the best known measure applied to financial statements. The maintenance of adequate working capital in a business and a good working capital ratio are of the greatest importance. Lack of sufficient working capital often hinders operations and prevents profitable developments. A favorable ratio of current assets to current liabilities is essential also to a good credit position.

While concerns are commonly expected to maintain a ratio from two to four dollars of current assets per dollar to current liabilities, statistics from various industries reveal no definite characteristics. The average ratio shown for 241 companies in the years 1916-1921 was $3.02 of current assets per dollar of current liabilities.

Analysis of Changes in Working Capital

Changes in working capital should be carefully analyzed and noted from period to period. Every withdrawal of funds from working capital should

be considered as its effect upon the working capital position of the concern, and that position should be protected.

Those factors which tend to increase the amount of net working capital include:

Surplus net profits earned.

Provision for depreciation on fixed property investments.

Reserves pertaining to other than current assets, such as sinking fund reserves.

Those transactions which represent withdrawals from working capital funds include:

Losses sustained.

Cash dividends paid.

Deposits in sinking fund.

Some Electrical Developments During 1927

By John Liston

There were, during the year, numerous improvements in design, in process work, and in manufacturing methods which resulted not only in improved efficiencies, but, in certain classes of electrical equipment, combined this result with lower costs. The economies thus secured were shared with the consumer through the medium of reduced prices in the classes of apparatus affected.

New records in the unit capacity of steam turbine generators were achieved in both the single-cylinder and tandem-compound types, with single generators rated 75,000 kw. and 160,000 kw. respectively. The maximum capacity of the cross-compound type, represented by the 208,000 kw. set under construction, was not exceeded. There was an increased use of high pressures, many of the large turbines utilizing steam at pressures up to 600 lbs. There was also a pronounced tendency to utilize higher steam pressure for the industrial type of turbine than had been previously considered practicable.

In the fabrication of large generators for both turbine and water-wheel drive, synchronous condensers and similar apparatus, there was an increased use of structural-steel and steel-plate welded construction, this method having practically superseded the use of large castings in the building of machines of this class. Another feature of great importance was the cooling of these machines by an enclosed system of circulating gas which not only permits a more accurate control of the temperature than air cooling, but enables the machines to operate with a higher output than was possible with former methods of cooling.

There were two events of outstanding importance in the marine equipment field, the first being the placing in commission of the airplane carrier, "Saratoga," the most powerful craft afloat. With her electric propelled equipment of 180,000 shaft h. p., this ship utilizes approximately as much energy for propulsion as six battleships. The second event was the completion of the turbine-electric passenger liner, "California," with the highest-rated electric propelling equipment in the merchant marine service. She is also the largest craft of her type so far constructed in an American shipyard.

Four motor-generator type locomotives each rated at 260 tons were built for the Great Northern Railway, which receive alternating current at 11,000 volts and convert it to direct current for the driving motors. The Chicago, Milwaukee and St. Paul railroad completed the electrification of its entrance into the city of Seattle by the equipment of a 10-mile, double-track line.

The system of automatic control of the machinery in power stations and substations was utilized for plants of greater capacity in hydro-electric power stations, and in railway, mining and industrial service. Railway substations were to an increasing extent equipped with mercury-arc power rectifiers which have now been in service for a sufficient length of time to demonstrate their dependability.

Many ingenious applications were made of vacuum-tube control for switching, protective and indicating devices in power stations and on transmission lines. These were developments supplementing the use of carrier-current communication, which was also further extended during the year, and indicates the possibilities of a great variety of uses for vacuum tubes for purposes other than radio broadcasting and receiving.

The successful operation of the 132 kv. oil-filled type of conductor cable greatly enlarged the scope of the economical, underground transmission of large blocks of power. This method is of maximum value where it is desirable to operate high-voltage conductors in cities or other congested areas.

There was a well-defined tendency toward the further adoption of complete, self-contained, switching systems in which the circuit breakers, switches, busbars, and auxiliary equipment were all metal-enclosed and connected to oil reservoirs which maintain the oil at a suitable pressure throughout the switching group. Modifications of this system utilized fluid or semi-fluid compounds in place of the oil. This same method of complete, metal enclosure of the equipment was also adopted for subway-type transformers.

In presenting a review of these and the many other developments which occurred during the year, all the apparatus referred to are products of the General Electric Company. These cover such a wide range that the references will serve as an indication of the tendencies in design and construction as well as the general progress in the electrical manufacturing industry as a whole.

THE WIRE SAW IN SLATE QUARRYING

By J. R. Thoenen,
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SINCE the publication of the preliminary report on this subject in July, 1927, (The Wire Saw in Slate Quarrying, Preliminary Report, Serial No. 2820, by Oliver Bowles), the wire saw has been in constant daily operation at the quarry of the Colonial Slate Company. During this time between twenty and thirty successful cuts have been made varying in length from forty-five to ninety-two feet and in depth from six to ten feet. No accurate time records have been kept on these cuts but they have been totaled over 12,000 sq. ft. of area and required 19,000 lineal feet of wire.

During these cuts the average speed of cutting has risen from the 12.8 sq. ft. per hour obtained in the original recorded tests to between 15 and 20 sq. ft. per hour, with the present rate running very close to 20 sq. ft. per hour at this quarry.

This increased cutting speed is a natural result of increasing familiarity with the characteristics and abilities of the saw and greater skill in its manipulation. Some of these cuts were in hard ribbons while others cut the ribbons transversely; thus the cuts were made under unfavorable as well as favorable conditions. The cumulative results are therefore indicative of possibly even greater efficiency in the use of this tool.

The Colonial Slate Company has purchased additional equipment and has four standards in use. Channeling machine work has been practically abandoned except for making short cuts, for example, in cutting out small sink holes in which to place wire saw standards.

The increasing success of the tests has made its influence felt in the entire district. Many operators have observed the saw in action and its accomplishment has so impressed them that two other companies have purchased and installed wire saws which are now in daily operation. Other companies have ordered saws for immediate delivery, and several companies are making definite plans to operate them in the spring of 1928.

Two Cuts with One Wire

Recently experiments have been run by the Colonial Slate Company whereby two parallel cuts a short distance apart have been made simultaneously with a single wire. Two extra standards were obtained from local manufacturers embodying improvements over the imported standards suggested by experience. Thus four standards were used and the wire strung first through one pair for one cut and then to the second pair for the second cut before returning to the drive mechanism. Each of these cuts averaged forty-five feet in length and ten feet deep equaling a single ninety foot cut. They were put down at approximately the same speed as single cuts (20 sq. ft. per hour), and caused no trouble other than that required in setting up the extra standards.

Equipment for Sinking Standard Holes

The Belgian drum drill with its forged teeth, using sand as an abrasive, was not successful as a means of sinking standard holes. The reasons for this were, the cumbersome nature of the tool itself, the time required to move and set it, its inability to cut holes other than vertical owing to the excessive friction set up between the long drum and the walls of the hole, and the excessive wear on the cutting teeth.

Failure of this equipment after repeated trials led to search for some other equipment more flexible and better suited to the problem. Officials of the Ingersoll-Rand Drill Company became interested and through their cooperation various schemes were tried.

An attempt was made to sink a hole by drilling a circle of small diameter holes with an air hammer drill mounted on a rotary arm. The webs between the drill holes were removed with a broaching tool thus giving a circular cut. This worked satisfactorily for shallow depths but for deep holes the binding of the tools and various other difficulties made the process so slow and unsatisfactory that it was abandoned. An attempt to drill a circle of larger holes with a shot drill was likewise unsatisfactory.

Having determined the feasibility of cutting the slate with steel shot as an abrasive albeit the failure of the above methods it was next determined to attempt drilling holes at a single cut large enough in diameter to accommodate the saw standard and guide wheel.

For this purpose an experimental machine was constructed consisting of a simple revolving gear driven head so mounted on a fabricated steel frame as to allow inclination up to 45 degrees radially in line with the long axis of the frame. Power was supplied through a sprocket and chain drive from an eleven horse power four-cylinder Continental gasoline motor mounted on one end of the frame. A hand operated clutch built integrally with the motor allowed starting without load.

The drill mechanism consists of a hollow steel shaft or drill rod splined to the revolving head with the key seat running the full length of the rod of approximately four feet. To the lower end of the drill rod is attached, by screw thread and coupling, the cutting bit or drum varying in diameter and construction with the size of the hole

to be drilled. Additional drill rods with screw couplings can be inserted between the driving mechanism and the cutting drum as the depth of the hole increases.

As a preliminary experiment a twenty inch diameter bit was first attached and tried. With this equipment a hole ten feet in depth was drilled without trouble.

To allow ample room for the saw standard and 28 in. guide wheel a hole at least 36 in. in diameter was necessary. As no standard tubing of this size is available a special tube was rolled from five-eighths inch steel plate. This drum was built 30 in. long and 3 in. from the upper end was internally supported by a five-eighths inch steel circular plate or head to which the drill rod was fastened and the whole welded together.

Six two-inch slots 4 in. long cut diagonally towards the direction of rotation in the bottom edge of the bit were provided for freeing the drill shot.

With this equipment ready the drill was set up in the quarry of the Colonial Slate Company on September 10.

The hole was pitched approximately perpendicular with the plane of the split of the slate, or at 68 degrees from the horizontal. Some mechanical trouble was encountered as might be expected from such a roughly constructed experimental machine. The removal of the core itself presented a rather perplexing problem but was finally solved. In sequence of events the operation was as follows:

The drum was revolved on the flat split of the slate using sand fed by hand as an abrasive. When the drum had cut to a depth of 2 in. it was raised and steel shot placed in the cut. The drum was then lowered and the drill started at a speed of 60 R.P.M. The drum, weighing 900 pounds itself, and drill rods provided sufficient weight for comparatively rapid drilling in this quarry.

When the drum had cut down to the limit of its internal length (when head rested on the core) drilling was stopped, the drum hoisted by chain blocks operating on a built up pipe headframe constructed on the drill frame, and set to one side.

Some broken pieces of core were removed but the major portion was found to be firmly attached to the solid slate. The core was broken loose, hoisted by the chain blocks, and removed in one piece. More shot was placed in the hole and drilling continued. This process was repeated each time the drill had cut to the depth of the barrel unless broken core stopped operations sooner. As the hole deepened much time was lost in removing water after lifting the drum preparatory to removing the core. After completing the hole, measurements showed the bottom edge of the drum to have been worn off three-eights of an inch. About 20 lbs. of steel shot and 20 gallons of gasoline were used.

After completing the initial hole at the Colonial quarry the drill was taken to the quarry of the Chapman Slate Company and two ten-foot holes were bored. The slate here is much harder than at the Colonial and provided a much more conclusive test for the drill.

Drill Operations at Chapman's Quarry

In starting the drill it is necessary to use sand as an abrasive owing to the physical inability of keeping shot under the cutting edge of the drum prior to the wearing of a starting ring. The first hole at Chapman's quarry started in this way was observed to cut 3 in. in the first hour. Shot being then introduced the next 18 in. was cut in 1½ hours, which illustrates the rapid increase in speed with shot.

Upon completing the first cut to the depth of the barrel, recharging the cut with shot and again starting, it was noticed that the speed of cutting was greatly reduced. The reason for this was assigned to the buoyant action of the drilling water introduced through the drill rod to the interior of the drum. At the start of this second cut the cut was not sufficiently deep to allow submergence of the drum, and the water in the interior being forced to travel under the cutting edge and out around the outside of the barrel tended to lift the barrel and counteract the weight of the drum itself. To remedy this, tripod drill weights aggregating 400 lbs. were suspended from the swivel head at the upper end of the drill rods. With this added weight the rate of cutting immediately increased to its former speed.

This cost should be considerably lowered in future holes. It must be borne in mind that the machine with which this hole was drilled was only an experimental one and no provision was made for apparatus for either lifting the heavy core nor removing the water from the hole.

It is interesting to note here also that these holes 36 in. in diameter are probably as large if not the largest ever drilled by a shot drill.

The Ingersoll-Rand Drill Company are now actively engaged in developing a new type of drill for this work based on experience gained from these holes.

At the Jackson-Bangor Quarry

On September 8, the second saw in the district was placed in service at the Jackson-Bangor Slate Company quarry, at Pen Argyl, Pa. The slate in this quarry is somewhat harder than that in the Colonial although both are on the Albion Run which is classed with the so-called "soft-vein" slates. In an attempt to make this initial cut particularly severe the saw was set up to cut longitudinally through the hard siliceous ribbon immediately above the "genuine" bed. This is the hardest ribbon in the quarry.

The standards were placed 125 ft. apart at each end of an open block of slate thus requiring no

standard holes to be made with the shot drill. After 62 hours running time 457 sq. ft. had been cut at a cutting speed of 7.4 sq. ft. per hour. The last few hours, however, the rate had considerably decreased. Examination of the wire showed a loss of roughly one-thirty-second of an inch in diameter and the outer surface of the exposed strands to be worn quite smooth. This condition was thought to account for the lower rate of cutting, in that the groove was insufficient to draw the requisite amount of sand into the cut. It was also decided that the saw had been forced too heavily at the start, which in this hard ribbon had resulted in undue wear on the wire.

The results of drilling in the two quarries are given in the following table:

	COLONIAL QUARRY		CHAPMAN'S QUARRY	
	Belgian Drill Hole No. 1	I. R. Shot Drill No. 2	I. R. Shot No. 3	I. R. Shot No. 4
Total elapsed time	45 hrs.	29 hrs.	40 hrs.	23 hrs.
Total drilling time	13 hrs.	13 hrs. 44 min.	19 hrs. 33 min.	15 hrs.
Total setting up time	25 hrs.	2 hrs.	3 hrs.	3 hrs.
Total tearing down time	1 hr.	40 min.	1 hr.	3 hrs.
Total removing core time	6 hrs.	12 hrs. 36 min.	16 hrs. 27 min.	13 hrs.
Total depth of hole	78 in.	122 in.	122 in.	124 in.
Av. depth of hole per hr.	7.48 in.	9.4 in.	6.24 in.	8.27 in.
Cost per ft.	$8.51	$3.32	$5.31	$4.49

An attempt to run in a new wire and ream out the first cut was tried but failed. The standards were then reset in a new position to cut parallel but about one foot below the initial cut. The saw was run in this second cut for about 19 hours when the wire again stuck and stopped. Examination showed the reason to have been the movement of the narrow beds (1 ft. from the first cut) so as to pinch the wire, and also movement of debris in an old channeled cut through which the wire ran.

The standards were again moved, a new wire strung, and a third cut started in the edge of the "genuine" bed which is the hardest of the slate beds but not as siliceous as the ribbons. This cut was 91½ ft. long and inclined at fifty-two degrees from the horizontal in order to follow the natural dip of the bed.

A finer grade of sea sand containing some small amount of clay was used at the start but it was noticed that when too much water was added the mixture seemed to emulsify causing the sand to ride on top of the wire and reduce the cutting speed. Only a small amount of this sand was available and a clean silica sand manufactured from sandstone was next tried and proved quite satisfactory.

At the start five sand boxes were used and it was found rather difficult to adjust the proper amount of sand and water. During one two-hour period one of these boxes (nearest the final end of the cut) was removed and it was observed that the cutting speed increased. During the next two-hour period a second box was removed without lessening the cutting rate. This showed the possibility of conserving the quantity of sand used and also provided easier control as the spigots on the remaining three boxes could be opened wider and the volume of water better controlled.

This cut was entirely successful and when completed measured seven feet nine inches in depth and 91½ ft. long, making a total of 709 sq. ft. To this must be added 26 sq. ft. for a projection at one end of the cut or a total of 735 sq. ft. in all. The actual running time was 90 hours and the average cutting rate 8.17 sq. ft. per hour.

The standards were then reset for another cut 131 ft. long which was completed without mishap at an average rate of 9.5 sq. ft. per hour.

At Chapman's Quarry

The Chapman Slate Co., at Chapman's Quarries purchased a complete wire saw outfit and started their initial cut on October 15. This cut was completed on October 19, without serious trouble. Several short stops were made as a result of mechanical trouble with the power unit, but these caused no inconvenience other than to delay the completion of the cut.

In the previously recorded cuts at both the Colonial Slate Company and the Jackson-Bangor quarries the power unit driving the saw consisted of an electric motor driving through a series of counter shafts and belts to obtain the required speed reduction. At the Chapman quarries the power was supplied by a 10 H.P., 220 volt induction motor coupled to a speed reduction unit made by the Philadelphia Gear Works.

The Chapman quarry is on the so-called "hard vein" slate which, although differing little in chemical composition from the soft vein is nevertheless considerably harder. Considerably slower cutting speed was anticipated and in consequence a short cut was tried first. The cut as completed was 41 ft. long and 10 ft. deep and was finished in 36 hours running time or at an average speed of 11.4 sq. ft. per hour.

Careful measurements were made at various

periods and hourly speed rates determined ranging from 5 sq. ft. per hour to 17.2 sq. ft. per hour. The variation was caused by varying rates of feeding the guide pulleys on the saw standards and the maximum rate is indicative of what may be anticipated when the operating personnel becomes better acquainted with the manipulation of the equipment.

The successful cutting of this harder slate and the comparatively higher rate of speed than was expected suggests the possibility of the utilization of the saw in much harder formations than slate and thus opens the potential field for this equipment to many other of the rock product industries.

Upward Curvature of the Saw Cut

As mentioned in the preliminary report the upward curvature of the wire saw between the guide pulleys caused some apprehension as to its ultimate success. Continued experiments, however, have proven that this is a minor problem, cuts having been made 45 feet long with a maximum upward curve of only two inches and 90 ft. long with less than six inches. Operation of the saw after complete lowering of the guide pulleys and increased tension on the rope are the only requirements.

Screen analyses were run on four different kinds of sand used with the following results:

Screen Tests of Sands Used (In percentages)

	1	2	3	4	5
Plus 10m	0	0	0	0	1
Minus 10m Plus 20m	0	6	3	0	3
Minus 20m Plus 35m	0	60	25	3	*96
Minus 35m	100	34	72	97	..

*No. 35m screen used.

No. 1. Gray sand used at Jackson-Bangor quarry.
No. 2. Coarse white silica sand used at Jackson-Bangor quarry.
No. 3. River sand from local pit used at Jackson-Bangor quarry.
No. 4. Fine white silica sand used at Jackson-Bangor quarry.
No. 5. Sea sand used at Colonial quarry tested December, 1926.

Samples Nos. 1, 4 and 5 gave the best service. The No. 3 sand was found to contain too many pebbles and also too much loam. The No. 2 sand was reported as too coarse with a tendency to bind the saw in the cut. Unfortunately this difficulty did not occur during the presence of the writer so he does not feel inclined to condemn this coarser material without further trial. The rate of cutting when using Nos. 1, 4, and 5 sands was affected by too many other features to determine whether one was better than another. All worked apparently equally well.

Conclusions

From the results of the tests so far with the wire saw it is evident that it will cut twice to four times as fast as a channeling machine and at correspondingly lower cost.

The saw requires one man only to operate and where a small air hoist is available not more than two men are necessary to move it from one set up to another.

There is little or no waste directly attributable to the saw cut except the actual rock cut away.

The smooth surface left by the saw on the quarry blocks can be utilized to reduce preliminary mill sawing.

The saw can be run 24 hours daily if desired without other than regular attendant labor.

The development of the core drill has adequately solved the problem left open by the failure of the Belgian drum drill and thereby made the saw available for those quarries having no other means of opening sinks for the saw standards.

Recognition of the success of the wire saw in the slate field is evidenced by the purchase of complete equipment by six operating companies and of a second complete outfit by the initial operator. In addition to this several other operators in the Pennsylvania and other fields have in contemplation the installation of saws for the spring of 1928.

Interest has been shown by the operators of other materials than slate also, and it is hoped in a future report on progress to be able to include tests on other classes of rock.—Reports of Investigations, Bureau of Mines, Department of Commerce.

Auto Registration During 1927

Automobile registration during 1927 totaled 23,125,000 cars and trucks according to figures compiled by the National Automobile Chamber of Commerce. Comparing the registration to the miles of surfaced highways, the figures show that there are 40.2 cars and trucks in the United States for every mile of surfaced road. The total mileage of highways, including secondary roads, according to figures compiled by the American Motorists Association aggregate 3,006,081 miles. Primary highways total 575,000 miles.

Propose International Highway

The construction of an international highway, linking the United States with Central and South America, is provided for under the terms of a bill just introduced in the Senate by Senator Tasker L. Oddie of Nevada. The purpose of the highway, which is sponsored by the American Motorists Association and other organizations, would not only be for better highway facilities and communication between the countries, but would be conducive of good will, Senator Oddie declared in introducing the bill.

ACTION OF CEMENT AND GYPSUM ON LIGHT METALS

By Julius Meyer and Kirt Pukall

IT IS known that iron is not attacked by cement, but that quite the contrary when the iron is completely imbedded in the cement, the latter acts to protect it against corrosion. This protective action of cement is due on the one hand to the fact that the oxygen in the air cannot penetrate through the massive cement and concrete and come into contact with the iron or at least can do so only with very great difficulty. It is also due on the other hand to the fact that in cement we have a strong basic reacting medium and that bases have a strong retarding action on the rusting of iron. Iron is also maintained in a rust-free condition imbedded in gypsum. It takes a very long time before any trace of rust appears under these conditions. Other common heavy metals, such as nickel, cobalt, manganese and the like behave in the same manner when imbedded in cement and gypsum.

However, these metals are of no importance from a structural standpoint and the authors were hence more concerned with the manner in which such light metals, as aluminum, behave under similar circumstances. The problem that interested the authors was whether or not it was possible to substitute for iron in reinforced concrete structures and the like some other metal, which is not so heavy as iron. The question was whether or not it was feasible and practicable to combine iron with some other light metal in making these structures, so that their weight is considerably reduced.

This is reason why experiments were instituted with the purpose of investigating the behavior of aluminum, magnesium, calcium and the alloys of these light metals when in contact with cement, gypsum, etc. While formation of the oxide of the metal takes place in the case of iron and other heavy metals, when they come into contact with the oxygen in air, the aforementioned light metals possess the power of decomposing water with the evolution of hydrogen. Hence the quantity of hydrogen evolved forms a measure of the action of these media on the light metals. Inasmuch as these reactions commonly take place at the room temperature and rather slowly, the surface of the metals was made as large as possible in order to obtain useful results within a reasonable period of time. Hence large pieces of the metals were not used in the experiments, but rather the metals in their powdered forms, which were mixed with cement, gypsum, and the like. Then the entire mass was moistened to form a paste of suitable consistency. It was not necessary under these conditions to catch the evolved hydrogen gas. It was however possible to estimate the amount of gas that is evolved without involving any great inaccuracy, that is with an accuracy that is commensurate with the requirements of these experiments, by determining the increase in the volume of the paste.

The process that was employed by the authors consisted in mixing a definite mass of the finely pulverized metal with a definite amount of the gypsum or cement and sand, etc., then in adding such a quantity of water that a paste, which can be poured, is obtained, which paste does not separate out into layers on standing. This paste was filled into glass tubes of five centimeters diameter and twenty centimeters height, and after a certain definite time interval the height of the column of matter in the tubes was measured. Only small amounts of the powdered metal were employed in these experiments in order to make them as clearly defined as possible. The experiments were always started with 0.1 per cent of the metallic powder and then 0.25 per cent, 0.15 per cent, 1.0 and finally 1.5 per cent were used.

Aluminum

As is known aluminum reacts to a very slight degree with water, but when brought into contact with alkaline waters it will cause the decomposition of the water and the evolution of some hydrogen gas. Nevertheless aluminum will easily become coated with a protective, oxide film. When this film is activated with the aid of mercuric chloride and the like, it is made very reactive towards pure water. The fact that aluminum powder in contact with moist cement is able to evolve hydrogen gas has been known for a long time and practical use of this phenomenon has been sought along several lines. A mixture of fifty grams of cement, two hundred grams of sand and seventy grams of water does not show at room temperature the slightest increase in volume on the addition of 0.1 per cent of finely grained, grease-free aluminum powder, even after being allowed to remain for as long as one hour. On the addition of 0.25 per cent of aluminum the greatest increase in the volume amounted to only 2.6 per cent. When the amount of aluminum powder added was 0.5 per cent, the increase in volume was only 1.9 per cent and when the proportion of aluminum powder used was one per cent, the volumetric increase was even less, namely 0.6 per cent. On the addition of 1.5 per cent of pulverized aluminum the increase in volume was almost nil after the action had been allowed to proceed for a period of one hour. On the other hand when twenty drops of a two normal solution

of potassium hydroxide were added, the increase in volume amounted to 30 per cent within a period of five hours.

Another series of experiments were carried out with aluminum shavings, coarse aluminum particles, and aluminum powder of different size ofparticles, and all of these experiments showed that the action of cement on aluminum was only very slight.

Aluminum Bronze

Aluminum bronze behaved, however, in quite a different manner. After a one to two hour contact with cement quite an appreciable increase in the volume of the paste in the test tubes could be detected. It should moreover be mentioned that considerable difficulty was experienced in the experiments with aluminum bronze for the reason that the bronze was always floated away by the water and mounted to the surface, so that it was hardly possible to obtain a homogeneous mixture. It is remarkable that the results obtained with aluminum bronze could scarcely be duplicated in any two experiments or more.

The evolution of hydrogen gas, measured by the increase in volume of the cement paste, was very small in one experiment, and then again the increase in volume was very great in another test. Furthermore in one experiment the action was very rapid and in another very slow. Experiments, which were made to activate the aluminum, yielded no results at all. The use of activating reagents, such as mercuric oxide, and potassium cyanide, which gave very good results with pure water, were immediately rendered inactive by the basic ingredients in the cement.

It is consequently concluded that aluminum is attacked by cement in no measurable degree. A passive state is mostly attained, due probably to the condition that a protective film is formed, consisting of colloidal aluminum silicate. Aluminum behaves in gypsum the same as in cement. However in each case pure aluminum, when it is imbedded either in gypsum or cement, has been proven not to possess the requisite properties, particularly durability, of a building material.

Magnesium can scarcely be considered as a building material due to its high cost. Nevertheless it should be mentioned here that its resistance to the action of cement and gypsum is considerably greater than that of aluminum. However within a period of several weeks the oxidation penetrates quite deeply into the metal and it must also be concluded that this material, even if its cost were reasonable, is not suited for building purposes.

Calcium reacts very vigorously with wet cement and gypsum, in fact just as violently when they are present as in pure water, resulting in the evolution of a large volume of gas. This reaction cannot be retarded in practically any appreciable manner by the addition of other substances. Calcium cannot be considered at all as a structural metal. On the other hand it is possible that the alloys of this metal, which have been found to possess all sorts of important technical properties, can be used for this purpose.

Calcium-Magnesium Alloys

The alloy of calcium and magnesium, containing 60 per cent of calcium and 40 per cent of aluminum, when brought into contact with water in the finely pulverized condition, decompose the water at room temperatures with a slow but regular evolution of hydrogen gas. On the other hand this reaction is immediately stopped by the addition of a few drops of a water glass (sodium silicate) solution. A similar, passive action of sodium silicate can be observed when pure aluminum is tested under like conditions. For example this metal is gradually attacked by soda, but not by soda which contains small amount of water gas, as for example 0.05 per cent. Apparently a protective coating of aluminum silicate is formed on the surface of the metal under these conditions, which prevents the further action of the water. It is surprising that no reaction takes place between water and the finely pulverized aluminum-calcium alloy when placed in contact with moist cement. The evolution of gas and the increase in volume of the cement paste were very slight indeed even after a period of seventeen hours.

On the other hand gypsum had a very vigorous action on the metal with the evolution of considerable quantities of hydrogen gas. Thus an increase in volume, amounting to 50 to 80 per cent took place, when a thin gypsum paste was mixed with 0.25 per cent of the alloy. The evolution of gas was not complete even after the gypsum had hardened. Hence the gypsum was not mixed with pure water but with 0.1 per cent glue solution, where at the start of hardening was delayed by more than one hour. The evolution of hydrogen gas was both very vigorous and regular. On the

TABULATION No. I

No.	Alloy		Height of the mass in the test tube after the following minutes						Maximum height	After minutes	Increase in per cent
	Per cent	Grams	5	10	15	20	25	30			
1	0.0	0.0	9.2	9.2	9.2	9.2	9.2	9.2 cm.	....	...	...
2	0.1	0.3	10.5	10.7	11.1	11.5	11.5	11.6 cm.	12.5	65	36
3	0.25	0.75	11.5	13.3	13.3	13.8	14.2	14.4 cm.	14.6	120	59
4	0.5	1.5	13.1	14.7	15.8	16.2	16.2	16.4 cm.	16.8	40	83
5	1.0	3.0	17.2	18.3	18.4	18.7	18.8	18.3 cm.	18.8	25	104
6	1.5	4.5	17.5	18.7	18.2	18.3	18.3	18.3 cm.	18.7	10	103

addition of 0.25 per cent of the alloy the volume of the gypsum paste increased double within a period of one hour. The pores were small and uniformly distributed.

Alloys of calcium and magnesium were attacked not only by gypsum but also by mixtures of cement, sand and water. The experimental results obtained in a series of experiments in which various proportions of an alloy containing 70 per cent of calcium and 30 per cent of magnesium were mixed with 50 grams of cement, 250 grams of sand and 75 grams of water are given in Table I.

The increase in the volume of the mixture is not strictly proportional to the amount of alloy added. Inasmuch as the alloy is completely dissolved and hence corresponding quantities of hydrogen gas, a part of the gas must be evolved without increasing the volume of the paste sample. This is not remarkable for the reason that the cement paste was made with ignited, very sharp cornered quartz sand, and hence possesses slight colloidal properties, which induces the formation of foam acting to retain the gas bubbles.

Entirely similar results were obtained with sand and cement mixtures in the ratios of one to three, one to four and one to six. The alloys were completely decomposed and the cement paste was materially increased in volume and rendered very porous.

Tests were made with the idea of rendering the evolution of gas from the mixture of cement, sand and the alloy more difficult. The question here was whether it was not possible to reduce the action of the cement on the alloy in such a maner and to such a degree that the alloy could be recommended for making reinforced concrete structures. Hence substances were added to render the mass colloidal, and such materials as glue, gelatin, milk of lime and the like were added. The evolution of gas was just as vigorous under these conditions but the gas was retained by the mass of cement and alloy and colloid so that its volume was materially increased. Nevertheless a certain amount of hydrogen, quite considerable in quantity, escaped without taking part in this process.

Tests were also carried out on the important class of alloys which contain both magnesium and aluminum. These alloys are of considerable importance to the cement industry in that they are important structural materials and afford the possibility of being reinforced by means of concrete. It was found that these alloys were not attacked in any appreciable manner either by wet gypsum or cement. It was also found that it made no difference whether the alloy was used in the force of a compact piece or in the powdered form in these experiments. Nevertheless, after a period of several weeks had elapsed, clear evidences were observed of the action on the cement on the metal. The metal was covered with a white film which is composed of the oxides of the two metals forming the alloy. It could not be determined whether or not this coating on the metal exerted a protective action against further corrosion.

(While these experiments may appear to be of somewhat academic interest, they nevertheless show that there is some reason to believe that certain of the light metals and their alloys may be reinforced with concrete, containing cement or gypsum, without incurring any greater corrosion of the metal that takes place with iron. There is always the remedy of painting the metal before it is covered with concrete as is commonly done with iron. The net conclusion is that these metals and alloys should be neither arbitrarily rejected nor recommended for this purpose.)

Predicting Concrete Strengths With Increased Precision

By Herbert J. Gilkey

A layman will naturally feel pleased if job samples of concrete prove to be 20, 50 or even 100 per cent stronger than the pre-selected strength, but the function of the engineer is to build safely and economically. If 2000 pound concrete has been selected, 1000 pound concrete is a hazard and 3000 pound concrete is an extravagance.

Products of the different cement mills vary so much that the report of the Cement Committee of the American Society for Testing Materials on the cooperative tests of 32 different cements, conducted by 52 laboratories will doubtless show that the cement, in many instances may double or halve the strength of mortar concretes. In order to predict, through straightforward methods and reasonable accuracy, the strength that will be produced by a given cement and aggregates, we must know the strength of that cement and aggregates under a set of systematic conditions.

The usual variables for concrete are, the systematic factors and the factors caused by chance. There are reasonably parallel laws governing the behavior of given cements, aggregates and their manipulation are the systematic factors and are open to the same treatment and analysis as the water cement ratio relation. Tables of constants have been compiled and placed in easily usable form. Abrams' estimated strength may be assumed as a starting point from which to branch out and take account of the other systematic variables known or assumed to be present.

Report Building Vacancies High

The effect of the high building volume which the United States has experienced during recent years is beginning to be felt, according to the copyrighted January rental survey report of the National Association of Building Owners and Managers.

HIGHWAY CONSTRUCTION IN MEXICO

By Julio Garcia

Consulting Engineer of the Comision Nacional Decaminos Mexico, D. F.*

THE horse, and with it the use of carts and wagons was brought to Mexico by the Spaniards. The Spanish historians agree in saying that both the Government and the Catholic Missions had great difficulty in their constructive work.

The proper construction of highways was under the Viceroys, acting as delegates of the kings of Spain. They did it on a very small scale. During the Government of Gray Payo Enriquez de Rivera the road from Mexico City to the Sanctuary of Our Lady of Guadalupe was finished. The Association of Merchants built the road from Veracruz to Mexico via Jalapa, and the Consulate of Mexico built a road connecting these two towns via Orizaba. Viceroy General Jose Iturrigaray attended especially to the construction of the first; and the famous "Puente del Rey" was finished under the direction of General Jose Rincon. These are the only two highways built during Spanish domination. The Consulate of Mexico built the road from Mexico to Toluca, but it was left in a defective condition. The roads built by the Spaniards were largely trails that permitted and developed beast of burden traffic. From this time on, there are almost no records of road construction or the improvement of the existing trails to permit traffic of horse drawn carts and wagons.

After the independence of Mexico the poverty of the government would not permit the construction of more highways. The invention of steam engines and the construction of railroads superceded highway construction. A highway was built from Iguala to Chilpancingo in the State of Guerrero; the highway to Toluca was reconstructed, and a few others as well, in order to open new regions. The result of all combined efforts in building roads, up to the time of the inauguration of the present Federal Good Roads Policy, gave Mexico about 260,000 kilometers; 150,000 being wide trails, and 110,000 highways.

The present Federal plan calls for a system that will unite Mexico's productive regions and important towns. The first two roads built were those from Mexico City to Puebla and from Mexico to Pachuca. This first construction work allowed experimentation in modern methods. It is fitting to remark here of the collaboration and support of Charles L. Upham, during the organization and later as chief consulting engineer of the Comision Nacional de Caminos.

The present policy of good roads has given preference to the construction of two great routes to Acapulco and to Laredo. The first one of these roads was opened to traffic by President Cales on November 11, 1927, and is rendering good service; work is being prosecuted to finish the road. On the road from Mexico to Laredo, work has been continued and there are more than 300 kilometers opened to traffic from Laredo south through Monterrey.

Local materials are being used for surfacing, and the treatment known as Catchenite has been successfully applied on the roads. The treatment has stood well the present traffic and its convenience was made more evident during last year's extensive rainy season. There was not a case of washing or erosion. A gasoline tax was created for the Federal highway construction fund and incorporated to the Federal income.

It was not deemed advisable at the time of inaugurating the Federal Highway Construction to secure any loan for road building, but preferable to start the highway construction on a small scale with the resources available.

The Federal Primary Highway System includes seven principal routes; which construction is considered rather essential. These routes are as follows:

Route 1. From Mexico City to the frontier with Guatemala, going through Puebla, Oaxaca, Tehuantepec, and Chipas; branches to Villahermosa and Jamiltepec.

Route 2. From Chiapas to Yucatan through Campeche starting on a convenient point of Route 1; branch to Quintana Roo.

Route 3. From Guadalajara to Veracruz, through Zamora, Morelia, Zitacuaro, Toluca, Mexico, Tlaxcala and Jalapa; branches to Zihuatanejo via Uruapam and to Coalcoman.

Route 4. From Matamoros to the Port of Chamels on the Pacific Ocean, through the states of Tamaulipas, San Luis Potosi and Jalisco.

Route 5. From Port Altata, on the Pacific through Tepehuanes and Torreon to connect with the Mexico-Laredo road at a convenient point near Laredo.

Route 6. From Guadalajara to Ciuadad Juarez, through the states of Durango and Chihuahua.

Route 7. From the state of Jalisco to Sonora, on the Pacific Ocean.

At Fremont Peak the Rocky Mountain and Wasatch Mountain chains arise. The Rocky Mountains continued south into Mexican territory as the Sierra Madre Oriental, and the Wasatch Mountains as the Sierra Madre Occidental. Between these two principal mountain chains from the Rio Grande

(*Continued on page 90*)

*Abstract of paper presented before the American Road Congress, Cleveland, Ohio, Jan. 11, 1928.

SPEED REDUCERS

Use and Application in the Pit and Quarry Industries

By H. W. Munday

Part One

SPEED reducers during the last few years have come to be considered an economic necessity for power driven machines in the Pit and Quarry Industries. Their use today is general throughout the cement industry and they are also used in the crushed stone, sand and gravel, lime and gypsum industries. The interest in speed reducers in these latter industries has come to be quite marked during the past year. These modern speed reducers have a wide range of application in the Pit and Quarry Field and particular applications will be discussed in the second part of this article but in general they are used for drives to elevators, conveyors, hoists, kilns, coolers, grinding machinery, crushers, screens, agitators, mixers, pumps, and, in fact, are applicable to practically every piece of equipment that must run at slower speeds than the source of power. The use and application of speed reducers in all these industries is a timely subject for discussion.

In this short series of articles the discussion will cover the function of speed reducers, description of various types of units, principles of design and construction, the application of speed reducers in actual plants and features to be considered in selecting a speed reducer unit.

A speed reducer may be defined to be a compact unit representing an assembly of gears for securing a reduction in speed between a driving and a driven unit. The modern unit efficiently transmits the power and steps down the speed of electric motor, gas engine, or other similar sources of power. The unit is enclosed in a housing and occupies a minimum of space. The enclosed housing has a three-fold purpose. It retains the lubricants for the moving parts, it protects workmen from the working parts and it keeps out dirt and dust. There are many notable examples of improved efficiency through the installation of these units.

The economy of the high speed driving units has become well established and with its development has come the need for a compact unit for reducing their speed to the driven unit. The different requirements for speed reduction units have resulted in the design of many different types.

These various types of speed reducer units can be grouped into various classifications and for convenience the following classification will be used here.

1. Spur Gear Units
2. Worm Gear Units
3. Compound or Mill Type Units
4. Herringbone Units
5. Variable Transmission Units.

In the first four divisions all the units considered are of constant speed reduction while a separate division has been added to cover the variable unit.

Spur Gear Units

Under this division units with secondary gearing at 120 degree angles are considered. This division is further classified into plain spur, planetary and non-planetary types.

The spur gear type with secondary gearing at 120 degree angles is in extensive use in the Pit and Quarry Industries. There are several features which are common to all types of spur gear reducers. Except for those of special design, they are all of the straight line drive with the driving and driven shaft concentric. All types are enclosed and run in a bath of oil. The driving shaft and pinion are integral and the pinion is surrounded by two or more secondary gears with which they mesh. The load is distributed over two or more sets of teeth in the secondary gear train.

The plain spur gear type of speed reducer consists of a series of spur gears each revolving about its own center. The high speed pinion meshes usually with three idler gears making contact at 120 degrees points on the pinion. Integral with each of these gears or keyed to the same shaft is another smaller gear which in turn drives a larger gear, making contact at 120 degree points of the larger gear. This large gear is keyed to the slow speed shaft. The required reduction may be attained by proper gear ratios, or by making series combinations of the unit. Figure one shows diagrammatically the relationship of gears of this type.

Pinion A is high speed being keyed to a shaft which is coupled to the motor. It meshes with the three larger gears B bringing a reduction dependent upon the gear ratio. Gear C moving at this reduced speed further meshes at three contact points with D for further reduction.

Essentially there are five units to the plain spur gear reducers, i.e., the high speed shaft and pinion and three counter shafts each carrying a large and small gear with its shaft. A reducer of this type, although there are two reductions, is known as the single type plain spur gear reducer. The double plain spur gear reducer has a large case with a partition between two stages similar to the one just described. These stages are connected in series.

The conventional assembly of the plain spur gear reducer has the speed reducer placed between the

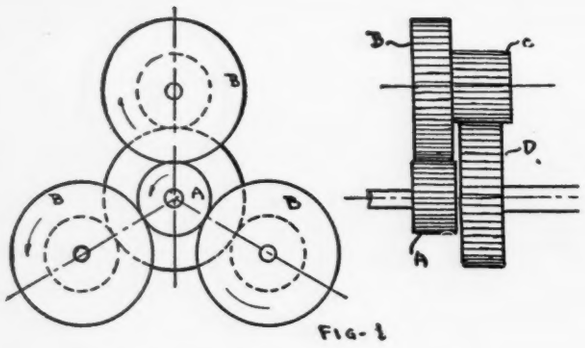


Fig. 1

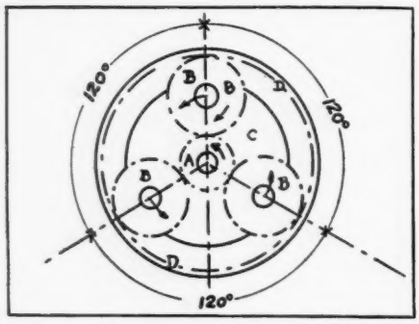


Fig. 2

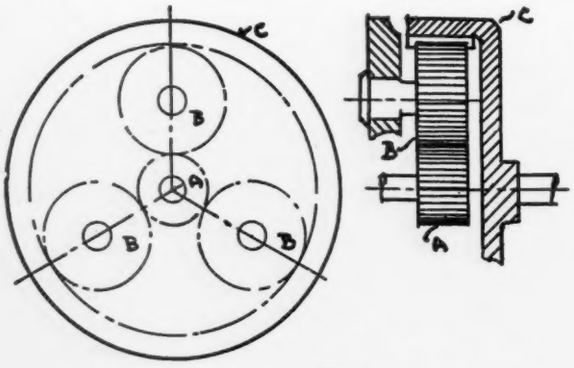
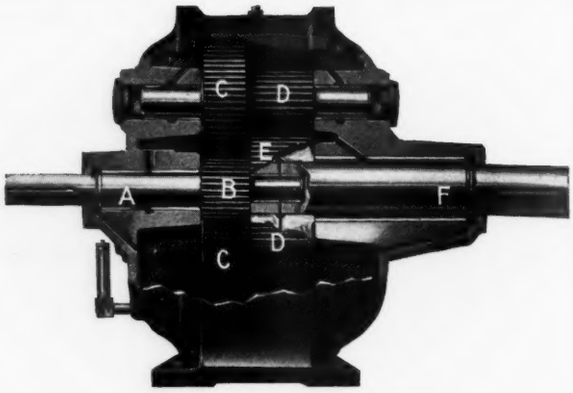


Fig 3.

motor and the driven unit with a flexible coupling connecting the motor shaft to the high speed reducer shaft. Another flexible coupling connects the low speed shaft to the shaft of the driven unit resulting in rotation at any predetermined speed. This final speed, however, depends upon the r.p.m. at the motor and the reduction ratio of the speed reducer.

A cast iron base is generally used for mounting both the motor and reducer making a complete speed reducing unit entirely self contained. The motor and reducer are occasionally placed directly on foundations or structural steel supports and the cast iron base eliminated but this method of installation is not to be recommended. The use of the cast iron base is recommended because it is more convenient when installing the unit and decidedly more substantial.

The planetary principle as applied to speed reduction units employs a high speed drive pinion, meshing with and driving three secondary gears which are mounted on the side of a free-running



A Jones Spur Gear Reducer

disk at 120 degree angles. These secondary gears also mesh with a stationary internal ring gear which is integral with, or keyed to the housing. As a rotative motion is applied to the drive pinion, it is in turn transmitted to the secondary gears. These, being journaled on a free-running disk and meshing as they do with the stationary ring gear, cause a rotation of the disk at a greatly reduced speed. As the disk is keyed to the low speed shaft, when used in a single stage reducer, it transmits this reduced velocity to the low speed shaft and thence to the driven machine or to a further reduction stage when desired.

The planetary principle of speed reduction is an old one and has been utilized in various forms of years, although its very early applications were not very successful. The difficulty lay in structural troubles rather than in any short comings of the principle itself. The last twenty years have found the planetary principle correctly applied and very successfully used in the most severe service.

Figure two illustrates the arrangement of gears and the manner in which they operate. The high speed pinion A is journalized in a long bearing and meshes with three intermediate gears B, which are journaled on the free-running disk at an angle of 120 degrees with relation to each other. As pinion A revolves in a counter clockwise manner, it produces a clockwise rotation in the pinions B. These three pinions also mesh in a stationary ring gear D and produce a rotation of the disk C, upon which they are journaled, in a counter clockwise direction. As the plate C revolves, it in turn causes the low speed shaft to which it is keyed to turn.

Any ratio of reduction may be obtained by using a series of similar reduction stages, all contained within the same housing. Reductions of 300 to 1 are not uncommon for this type of speed reducing equipment, while reductions of 2,500 to 1 are in daily use. In calculating the ratio of reduction in an ordinary train of spur gears the ratio of reduction is the exact ratio of the number of teeth in the driven gear to the number of teeth in the drive gear. In the planetary systems, however, since the secondary gears are journaled on the studs which are mounted in the disk, or slow speed

shaft members, it requires one more revolution of the high speed pinion than the ratio of the pinion to the internal gear to revolve the secondary gears around the drive pinion once.

In the planetary speed reducer the high speed and low speed shafts are subjected to torsional strains which should be amply large to carry whatever load is necessary. All other studs or shafts are subjected only to the turning moment imparted to them by the gears which they carry. The gears themselves bear all the strain.

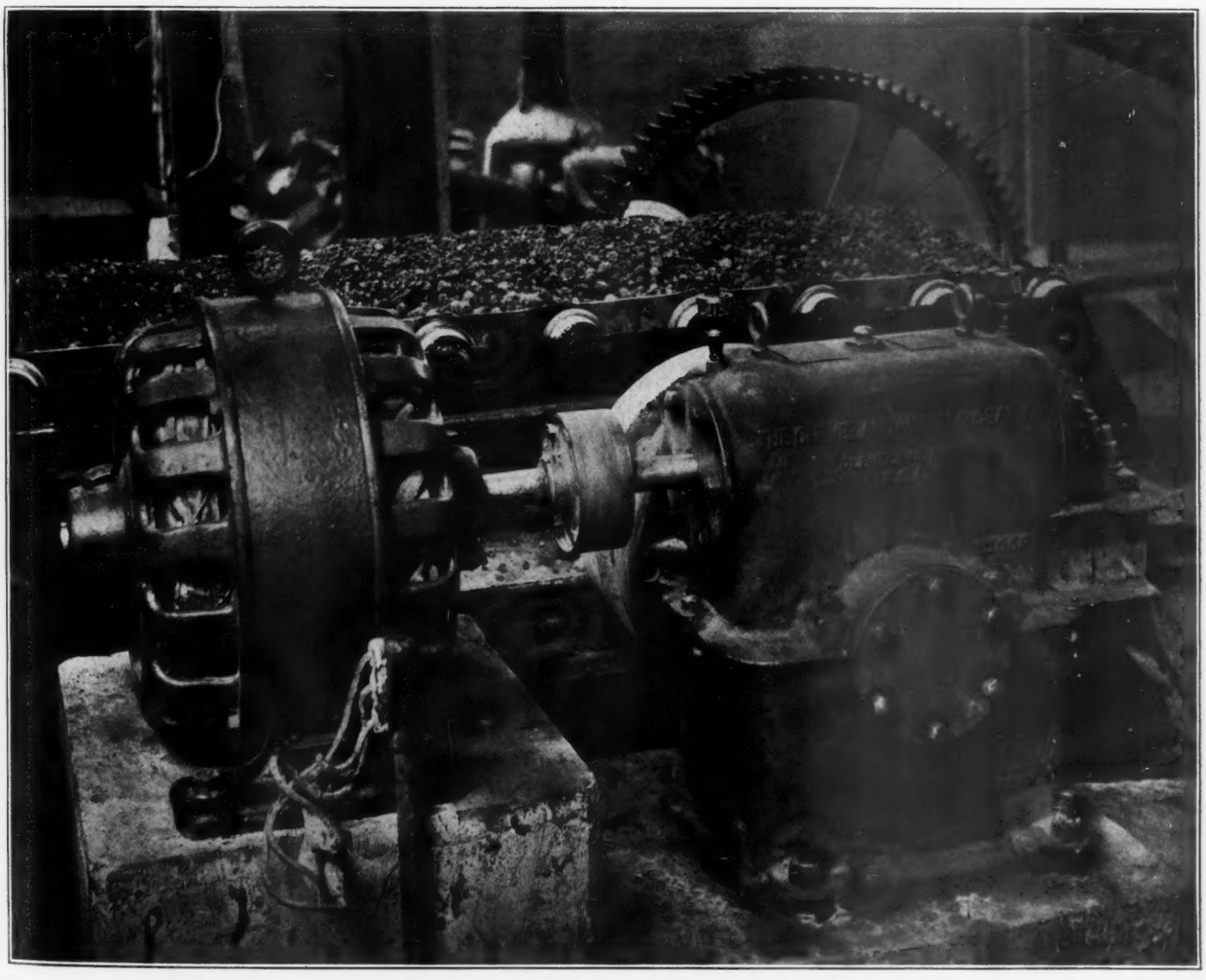
One of the most important features of planetary construction is that all stages of the internal rotating mechanism revolves in the same direction and build up an inertia which not only considerably steadies the operation of the unit, but which has a fly-wheel effect in meeting peak loads and fluctuating service. With the planetary construction all forces except the actual turning moment are balanced by equal and opposite forces, turning to apply the power at points where it can be used with a minimum of loss.

In the planetary speed reducer wear is corrected by simple replacement of bronze bushings in the secondary gears. Greatest stress and wear come at points where correction can be easily made. Theoretically, all parts float upon their bearings, and the only force except the turning moment, which must be sustained by the parts, is the weight of the parts in the internal rotating mechanism.

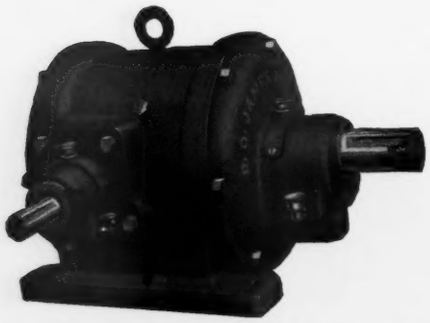
In the planetary construction it is possible to use a small tooth area and, consequently a small gear. Thus the idler gears may be made with sufficient tooth area to suit the high speed pinion, for in transmitting the power to the internal ring gear at a somewhat slower speed, two or more teeth are always in contact, dut to the concave shape of the ring, rather than one. The planetary type requires five gears per stage of reduction; the driving pinion, three intermediate gears, and the internal ring gear.

The fact that the entire internal rotating mechanism revolves about the high speed and low speed pinons, simplifies the lubrication problem, for all parts of the unit are completely immersed in the oil reservoir in the bottom of the casing at each revolution, not depending upon one part to carry oil to the bearing of another.

The non-planetary type of speed reducer employs a high speed pinion, meshing with and driving three secondary gears which rotate on fixed studs fastened to one end plate or to a partition cast



A Cleveland Worm Gear Reducer Driving An Akron Conveyor in the Phoenix Portland Cement Plant at Nazareth, Pa.



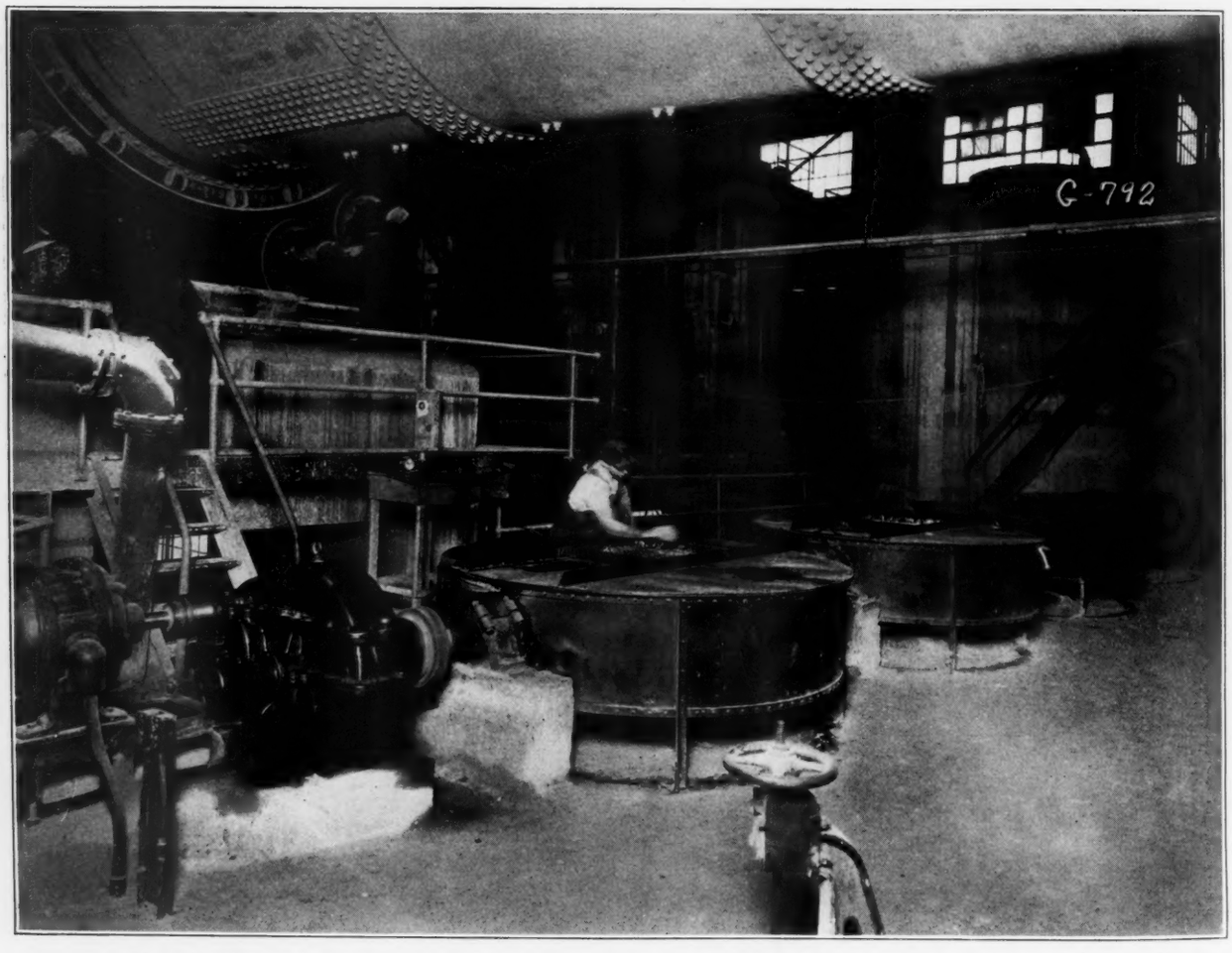
A James Planetary Angle Drive Spur Gear Reducer

integral with the frame. These secondary gears also mesh with an internal gear that is free to rotate. The low speed shaft is rigidly fastened to the internal gear.

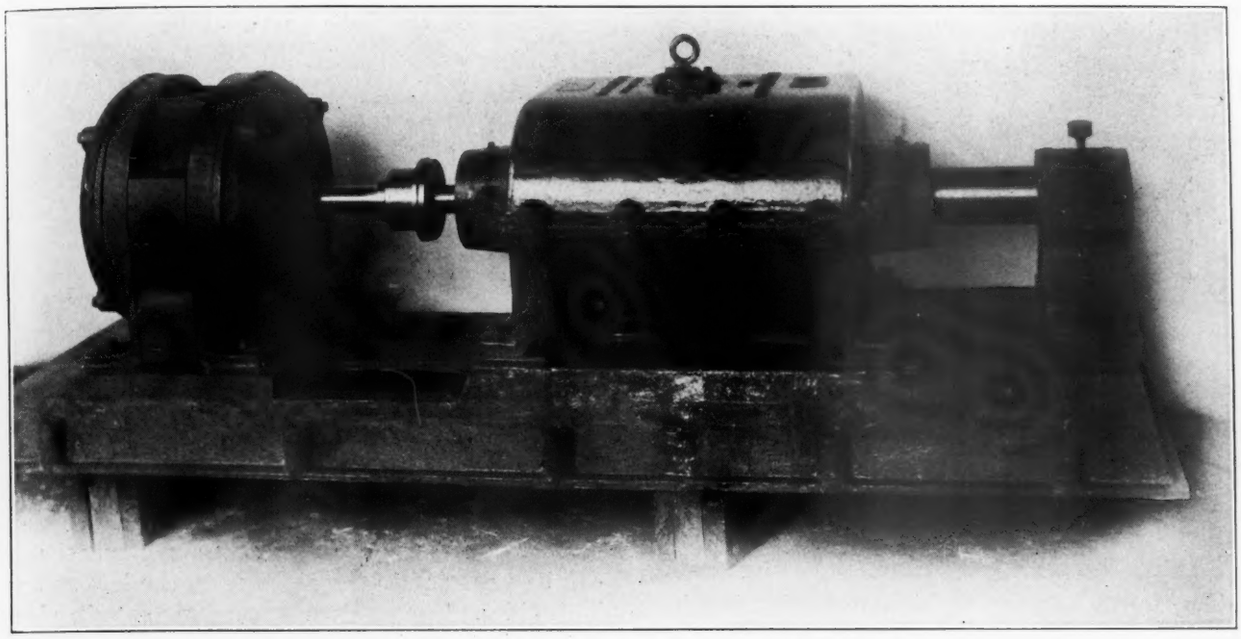
Figure three illustrates the arrangement of gears and the manner in which they operate. The high speed pinion A meshes with the three secondary gears B which rotate on fixed studs at an angle of 210 degrees with the relation to each other. These secondary gears are journaled in the frame. The secondary gears B mesh with the internal gears C which is free to move.

The torque arm on the low speed shaft in the non-planetary type is the distance from the pitch circle of the distance from the pitch circle of the internal gear to the center of the low speed shaft.

Two Falk Herringbone Gear Speed Reducers in the Plant of the New Egyption Portland Cement Company



Falk Herringbone Gear Speed Reducers in the Plant of the Wyandotte Portland Cement Company



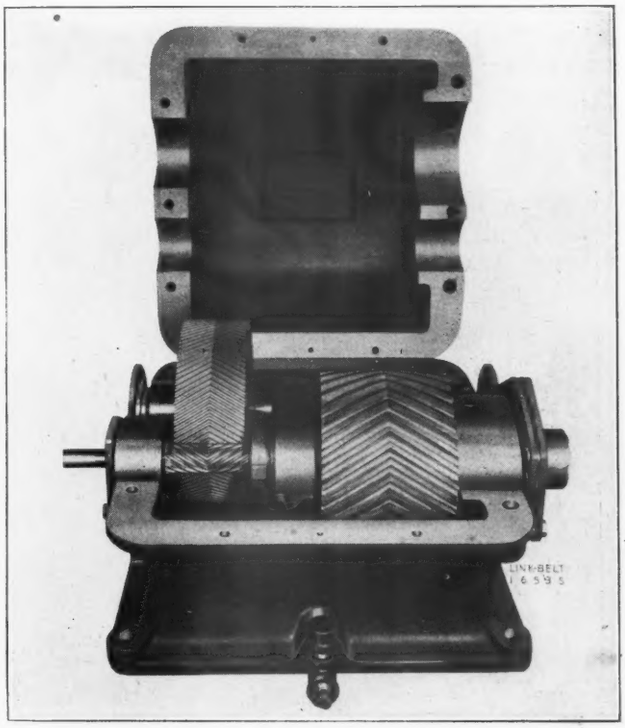
Complete Huron Mill Type Speed Reducer With Motor and Base

The torque here means the twisting force exerted on the wheel or shaft that tend to make it rotate and this force exerted on the wheel or shaft that tend to make it rotate and this force is equal to the product of the force exerted at the end of the lever multiplied by the lever arm. The non-planetary type uses a long torque to deliver power to the low speed shaft wth the object of delivering the greatest torque to the low speed shaft. With a given load, a given torque necessary to move it there will be less load on the internal gear, secondary gears and the high speed pinion when the lever arm is longer. The non-planetary type makes the torque radius as large as possible. Since the load is applied at three points on the internal gear, such force is one-third component of the whole because it is applied at the greatest possible radius, at the pitch circle of the internal gear.

The non-planetary type is simple in construction with only five moving parts for a single stage of reduction. These parts are one high speed pinion, three secondary gears and one internal gear. The movable internal gear and the direct drive are two of the efficient features of this type of reducer. All the secondary gears revolve on studs fastened to the end plate or to an internal partition and the possibilities of misalignment are practically eliminated.

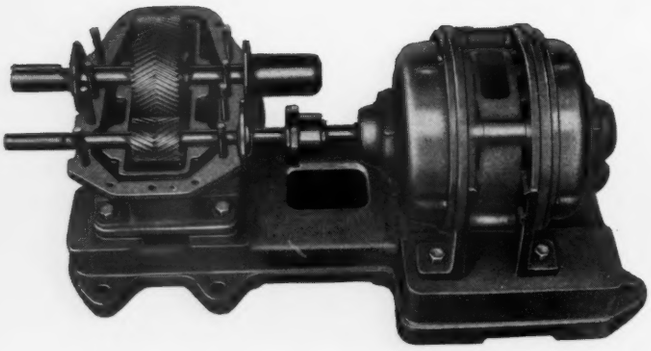
Worm Gear Speed Reducers

The worm gear speed reducer unit is a self contained fully enclosed unit consisting of a worm meshing in a gear which it turns as the driving unit is rotated. As the worm turns, the continuous spiral cut on its surface engages and rolls across the teeth of the worm wheel, imparting to these



A Link Belt Herringbone Speed Reducer With Housing Opened

teeth an action which moves them and causes the worm to rotate on its axis. The few working parts in a worm gear drive are an important mechanical advantage. Quietness of operation is an outstanding characteristic. The unit gives a positive transmission of power in any fixed ratio. The modern worm gear speed reducer unit is entirely encased in an oil tight and dirt proof housing. It is self lubricating, simple in construction and occupies a minimum of space. Single reduction worm gears transmit the power at right angles and may be either horizontal or vertical.



A Falk Single Reduction Herringbone Gear Reducer

A James Heavy Duty Worm Gear Speed Reducer

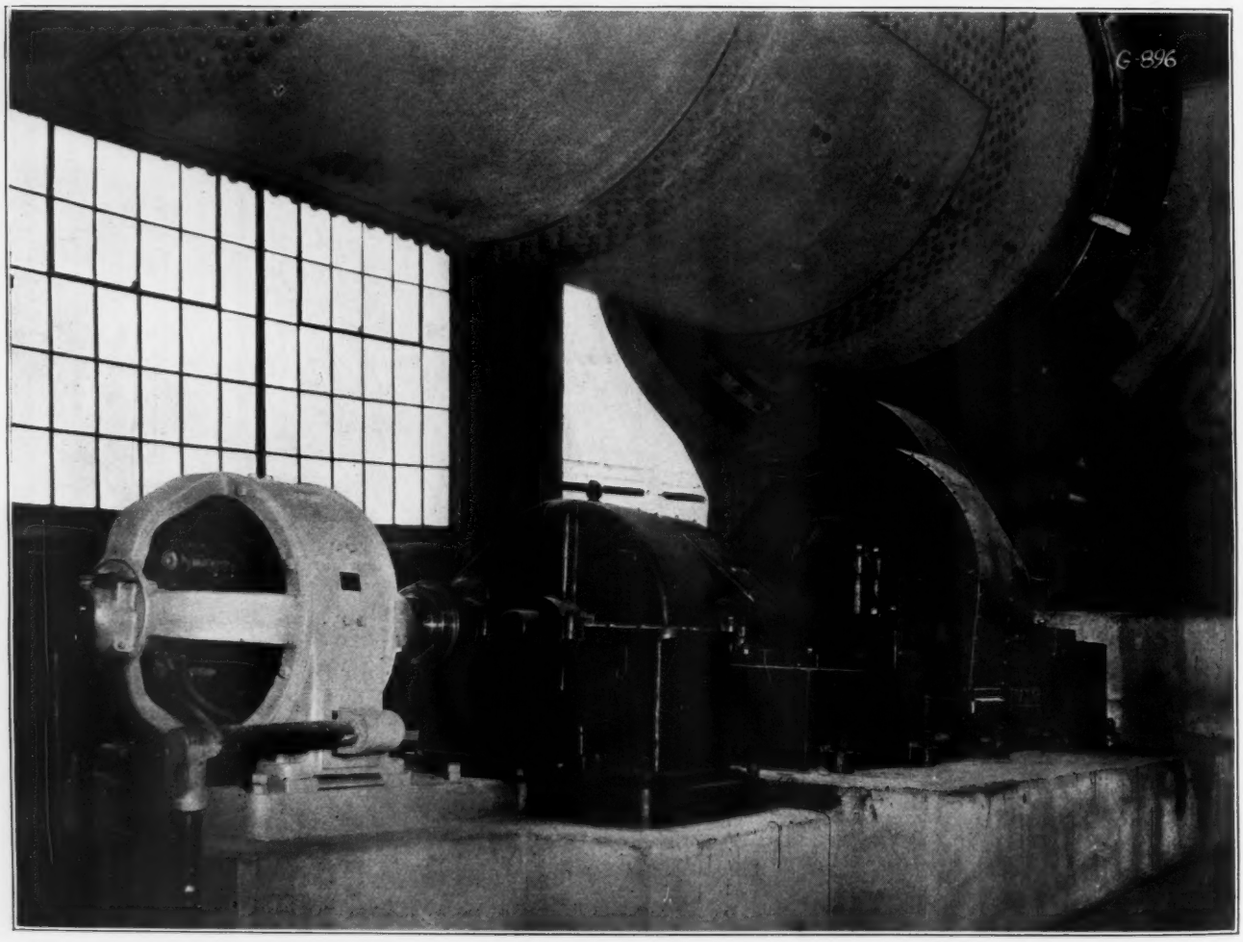
The worm gear speed reducer is made in three types:

1. With the worm below the gear.
2. With the worm above.
3. With the gear shaft vertical.

The worm is generally integral with the high speed shaft. The difference in elevation of the high speed shaft and the low speed gear shaft is the center of distance between the worm and the gear. The best transmission results when the gear is of bronze and the worm is of a case hardened low carbon alloy steel.

The right angle drive permits the motor being placed alongside the driven machine instead of at right angles. The worm can be placed either above or below the worm wheel and the worm wheel shaft can be extended to the right or to the left or upon both sides. The modern worm gear speed reducer in certain types is for direct coupling to the driven load, but in other applications ample bearings must be furnished to permit the use of an overhung pinion or sprocket wheel where chain drive is desirable for additional flexibility in the connection of the driven machine.

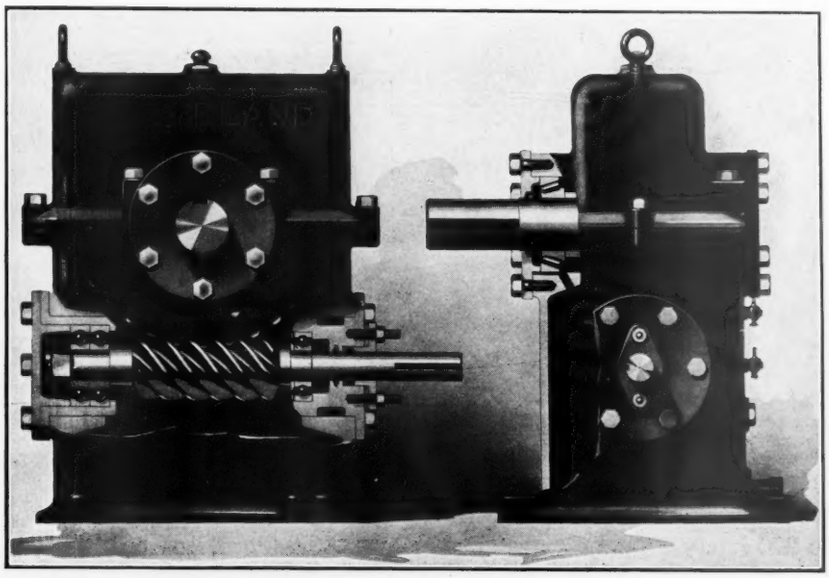
The characteristics of the loads to be carried are



Speed Reducer Driving in a Kiln in a Cement Plant

an important factor in selecting the proper work gear reducer. The characteristics of the load do not affect the worm shaft as it is mainly torque, but they do affect the gear shaft and its bearings. The gear shaft carries a torque load and often a heavy bending and shearing stresses due to the various methods of power take-off. Load characteristics may vary with the type of machine that is being driven by the speed reducer unit. Sudden stopping and starting of the machine subjects the speed reducer unit to shock loads which should not be ignored. When the power is delivered through a flexible coupling the load is generaly entirely torque, but when the power is delivered through a

A James Generated Continuous Tooth Herringbone Speed Reducer



A Cleveland Worm Gear Speed Reducer Unit

gear, pulley or sprocket there is a combination of torque, bending and shear. The diameter of the gear shaft should permit of a liberal load factor. The bearings should also be considered with the type of load in mind.

The modern worm gear reducer is made in sizes from ¼ to 150 h.p. and is used most generally where single reduction rations are within a range of 7 to 1 or 100 to 1. Double reduction types are available where a larger reduction must be handled by one housing. Still higher reductions are obtainable by combining worm and spur gear reducers which can be made to give a reduction as high as 50,000 to 1.

Mill Type Speed Reducers

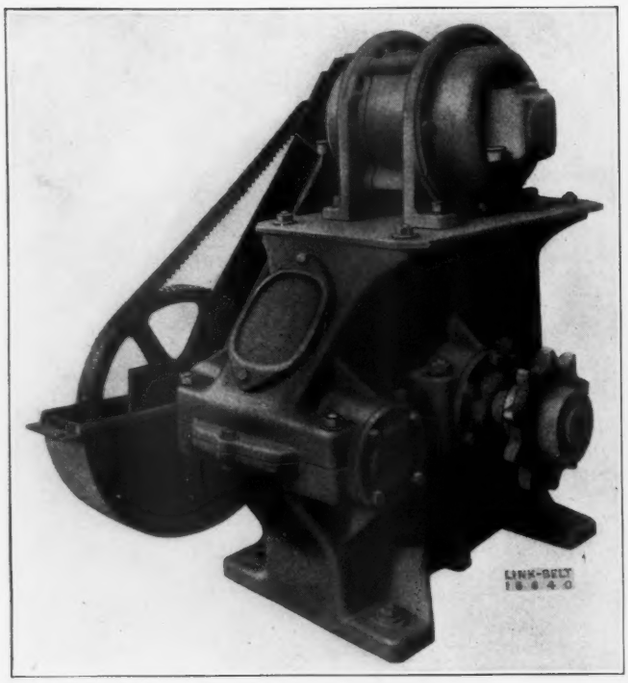
The mill type or compound speed reducer unit employs the gear and pinion principle and consists of a train of plain or helical spur gears revolving on fixed centers. The unit is entirely enclosed in a suitable housing. The shafts are parallel and in straight alignment with the driving unit. Reduction in the slower speed units is attained direct through a train of correctly supported spur gears. This type of speed reducer can be had with either two piece or three piece casings. The slower speed units are built with involute spur gears while those that operate at higher speed are built with the compound helical type of gearing. In the high speed units, helical gears are used for the initial high speed reduction with heavy duty steel spur gears following.

Rugged strength is a marked characteristic of the best of these units. The gears are of the heavy type made of high grade steel and accurately machined and designed for ample overload. The accessibility of the standard makes of this unit is a feature. All parts of the reducer are very easily accessible and there are no parts which are difficult to assemble.

The unit is especially adapted for low ratios of reduction and for heavy duty where all the gears are supported on bearings on both sides.

Herringbone Speed Reducers

This type of speed reducer unit is a modification of the spur gear train, but double helical or herringbone gears are used. The unit consists essentially of two single helical gears of opposite helical angles. The gear teeth are made "V" shape and



A Caldwell Speed Reducer With Casting Removed to Show Silent Chain Drive

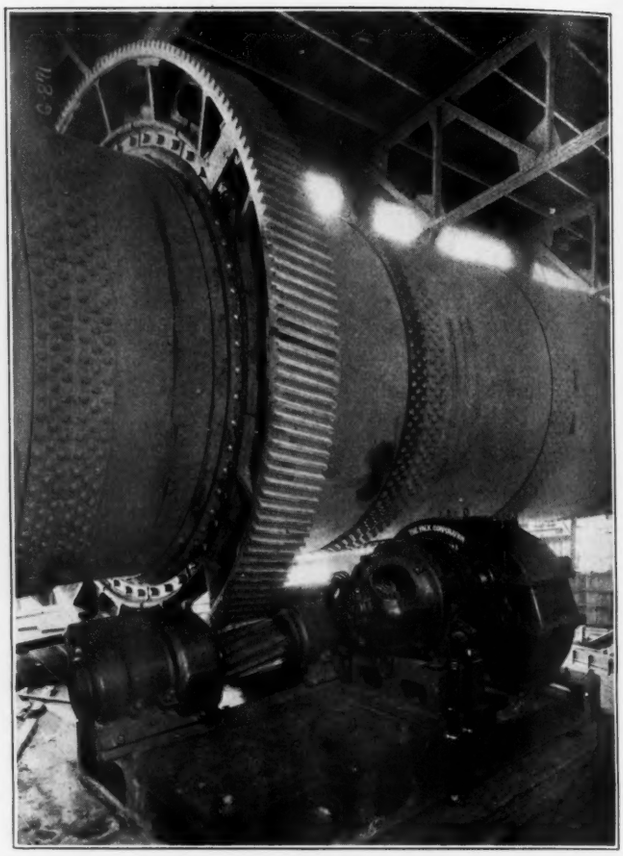
are cut involute with a pressure angle of 20 degrees and a helix angle of 30 degrees. Several teeth are in contact at the same time. The transition of pressure from one tooth to another is gradual and without shock. The unit is quiet in operation and the transmission is high. They are manufactured for reduction ratios from 2 to 1 up to 250 to 1 and for loads from 2 h.p. to 200 h.p.

This type of reducer transmits the load with the minimum of friction loss. There are few moving parts and the units are all accessible. The efficiency of the unit depends upon the accuracy with which the herringbone gears are cut. Gears for the small sizes should be made of high grade steel, while the gears of the larger sizes are made generally of special steel.

In this type of unit pressures are equalized on each pair of bearings at any load which means equal wear and correct alignment of gears. The gear ratio with this type of unit can be changed at a minimum expense.

Variable Transmission Units

All the previous types discussed have a fixed ratio of reduction. There are also speed reduction units which receive power at high speeds and deliver the same power at lower speeds. The rate of rotation of the low speed shaft may be decreased or increased over a wide range. These machines serve as speed reducers and speed changers. Only one type of such unit has been applied in the Pit and Quarry Industries to our knowledge, and this type will be described in the second part of this article appearing in the next issue, along with a description of particular units of the constant ratio of reduction types.



Speed Reducer Driving a Kiln From Center Support

Southern California Sets Record for Highway Building

The year 1927 will pass into history as the best to date in highway construction work in California, it is revealed in preliminary reports of these activities.

When the final figures for 1927 are available they are expected to show that in southern California alone more than $30,000,000 will have gone into new roads, new bridges, widening, resurfacing, realigning and general improvement.

These millions represent the total provided by the cities, counties, road districts, state and federal aid. While this estimate is only preliminary, it is believed to be conservative.

Good Roads Cut Tire Costs

Because of better roads, lower prices and higher quality the automobile tire expense is much less than it used to be, according to the National Automotive Chamber of Commerce.

The average per car per year for replacement of tires dropped from $82 in 1919 to $34 in 1925. Allowing for a further reduction in 1926, and using the accepted figures of $33 for repair parts, plus $45 for service labor and $13 for insurance, the cost per car is now about $121 per year for these items.

WORLD TURNS TO U. S. FOR HIGHWAYS

By Frank B. Curran,
Chief, Highways Section, Automotive Division*

THE Bureau of Foreign and Domestic Commerce assists firms by furnishing information concerning overseas markets; nature of the competition encountered and methods of meeting it; sources of supply of materials, especially raw products; tariffs; customs regulations; commercial laws; shipping and financing; and many other subjects that have a bearing upon market conditions abroad. New information regarding foreign fields is constantly being received from commercial attaches, resident trade commissioners, traveling trade commissioners, and American consular officers.

The Bureau maintains 23 district offices and 35 cooperative offices in the United States. It has commercial attaches and resident trade commissioners with permanent offices in 51 of the principal capitals and commercial centers of the world, and employs a corps of traveling experts who make reports of specific nature relating to their particular fields. Commodity, technical, and regional divisions interpret, digest, and compile the flow of commercial material coming into the Bureau and these divisions see that the information is made available to American business men. During the last year the Bureau obtained for American business benefits estimated at $500,000,000.

During the last four years, we have made collection of data on highways and highway transportation abroad, and every mail now brings us reports from far outlying posts of new roads planned or under construction, of larger appropriations for highway development, and of new opportunities for American trade. Columbia, Salvador, and Cuba award to American firms road construction contracts running into millions of dollars; Central Cuba's great Central Highway, 750 miles long, and costing $73,000,000, will be constructed mainly of asphalt; Argentina, South Africa, and Australia buy American road making machinery; Persia, the Soviet, and Panama employ American engineers to direct the development of their national highway systems; India plans to coordinate the work of road improvement under a central board; road construction in Java increases the demand for American asphalt; Australia adopts a federal aid system based on ours; and a Swedish engineer invents a new asphalt paving process.

These reports are handled in different ways, but with the definite object always of getting the news as quickly as possible to interested American firms. Brief items are published weekly in "Foreign Highway News," and articles of greater length and general interest in "Commerce Reports." To the Washington office of the Asphalt Association is given first hand information on road construction opportunities and markets for asphalt. We have issued "Motor Roads in Latin America," a book of 166 pages, illustrated with photographs and maps, describing the highway systems and methods of financing, construction, and maintenance of roads in the countries of South and Central America and the West Indies. Similar publications are now under way on Australia, New Zealand, and South Africa, while "Motor Roads in Latin America" is being revised and brought up to date.

This phase of our work involves bringing to American business men news of the existing foreign markets for their products or services, but another activity to which we have devoted much attention in the last 18 months is considered of even greater importance. In cooperation with the Asphalt Association the Highway Education Board, The Bureau of Public Roads, the Pan American Union, and a number of leading highway and engineering magazines, we have been carrying on a campaign to arouse interest in foreign countries in road improvement, especially by the use of American methods, materials, and machinery.

The purpose of this campaign is two-fold. First we hope by helping to improve transportation conditions in foreign countries, to increase the market for American products, such as asphalt and road machinery, American automotive vehicles and accessories, for gasoline and lubricating oil. Second we hope that in thus acting according to the dictates of what we may call an enlightened self interest, we shall also be serving the best interest of the foreign countries concerned. You all know what good effects, economic and social, have followed the construction of good roads in this country.

Recently, I had the good fortune to accompany a party of highway officials from Delaware who traveled to North Carolina to study the low cost sand asphalt roads which have been so successfully developed there. Every one I questioned on the trip gave me specific examples of increased prosperity of cotton and tobacco growers, banks, railroads, and business firms resulting from the improvement of roads, and pointed out beautiful new rural schools. The greatest impression received from the trip came from the realization that travelers from all over the United States were constantly passing over those roads, learning to know their country better, making new friends, and losing old prejudices. If this could be true as be-

*Abstract of paper presented before the Sixth Annual Asphalt Paving Conference, Atlanta, Ga., November 28, 1927.

tween states in this country, why cannot it be true as between countries?

It will be true, but before that time thousands of miles of roads must be built in foreign countries. Let us compare highway conditions in the United States with those in some neighboring countries. We have a mile of road for every 40 persons in the United States: Brazil has only a mile to 944 persons. Conversely, every person in the United States has 44 yards of road to walk or ride upon, while the Brazilian must be satisfied with less than two yards. We have a mile of road in every square mile and a quarter of area, and Brazil has only a mile in each 10 square miles. Chile has one mile of road to every 150 persons, or each Chilean has the use of 12 yards of road. Chile has a mile of road in each 12 miles of area. In 1926 Chile spent approximately 48 cents per capita on roads; Peru spent less than 25 cents; Uruguay a dollar and nine cents; and Salvador 30 cents, while the United States spent almost 11 dollars.

In some countries, notably Australia, which has adopted a Federal Aid system, great progress is being made, but in others like South Africa the work is hardly begun. The East is awakening, India and Japan are working on broad plans of road improvement. China is doing very well, but its vast area is still practically undeveloped as far as roads are concerned. Representatives of other ancient civilizations, such as Persia, Egypt, and Turkey, have learned the necessity of developing highway transportation. Even such countries as France and Germany find themselves faced with the necessity of reconstructing roads to meet the demands.

All the world wants roads, and all the world looks to the United States for the best example of modern highway development. Therein lies a wonderful opportunity for American skill and initiative to help in a work which will add immeasurably to the peace and prosperity of the world. In many countries road construction is limited by lack of funds, and the problem is to build a large mileage of roads at low cost. Is not that problem of tremendous significance to the Asphalt Industry?

The Bureau of Foreign and Domestic Commerce has welcomed the opportunity to cooperate in the development of highway transportation abroad. Every mail is carrying to our foreign offices data of all kinds on American methods of road construction, financing, and maintenance, furnished by the Bureau of Public Roads, the Highway Education Board, State Highway officials, The Asphalt Association and others. Motion picture films of road construction in the United States are being shown in 12 Latin American countries, and with the cordial cooperation of the Highway Education Board, we are planning to send similar films to other countries. Our representatives are cooperating with the Pan American confederation for Highway Education in its effort to organize branches of the Confederation in Latin America, and are working for the improvement of roads as one of the greatest factors in the social and economic development of the world.

(*Continued from page 80*)

south to the Valley of Puebla, lies what we know as Mesa Central. This Mesa Central is horizontal from east to west, and its elevation gradually increases north to south from Rio Bravo up to the valleys of Puebla, Mexico and Toluca. It has an area within the Mexican territory of 666,000 square kilometers and a mean elevation of 1,700 meters.

In the Isthmus of Tehuantepec, the elevation of these mountains decreases to the minimum of 200 meters, increasing again as they continue southward in the state of Chiapas.

Because of the above and other reasons, the commission has adopted what may be called a mixed route. Starting from Mexico City north on the Mesa Central up to parallel 22 degrees then crossing the Sierra Madre del Norte to continue on the high grounds between this Sierra and the coast up to the border at Laredo. This road is the same, with little deviations, as that proposed for the Meridian Highway, and affords the greatest advantages of any of the routes proposed to connect with the American Highway System.

An Interesting Highway Bill

A bill authorizing the creation of a special highway fund, providing a total of $407,341,145 to be allotted among the states in the same proportion as the Federal aid funds authorized each year, was introduced in the House on January 28th by Congressman Edward E. Browne (R) of Wisconsin.

The unique feature of the measure is that is does not add one dollar to the burden of the taxpayers of the United States. The bill providing for the utilization of this huge sum for highway construction, is in addition to the $165,000,000 Federal aid bill already introduced in both the House and Senate, which is known as the Federal aid bill.

The sum provided in the measure is to be obtained by the repayment of French bonds issued after the war covering an invoice of approximately $2,000,000,000 worth of property including road-building machinery which was ordered in June, 1919, by the War Department to be turned over to the Agricultural Department to be proportioned among the states for use in highway construction. Bonds totaling $400,000,000 mature on August 1, 1929, the remainder one year later.

Before the War Department's order for the return of the equipment was received in France, negotiations had already gone too far for the sale of the property to France, at approximately 20 cents on the dollar.

SELF-GOVERNMENT IN INDUSTRY

By S. J. Williams

ONE of America's greatest inventors and practical scientists, Mr. Charles P. Steinmetz, published in 1916 a remarkable book called "America and the New Epoch." Mr. Steinmetz was a keen student of the social as well as the physical sciences. In fact he was Mayor of his city for several years. His book contains many shrewd observations in our industrial and political affairs but I was particularly interested in his analysis of our industrial self-government. He pointed out how, in the practical things that affect the everyday life of the average citizen, we are dependent upon, in fact we are governed by business organizations much more than by political institutions. (He wrote, of course, before the Eighteenth Amendment!) New ideas, new inventions, new methods of manufacturing and selling that intimately affect every one of us, originate in industry, are developed by industry, and are recognized by government only in a negative sort of way, if and when they become so important as to require governmental control. If Mr. Steinmetz were writing today he might have said that the decision of Mr. Henry Ford, as to just what sort of automobile he should manufacture and at what price he should sell it, is of greater moment to the American people than the decisions of Congress on the European debt settlements, important though the latter may be.

This state of affairs is perfectly proper, according to Steinmetz. In fact, he maintains that industry and the leaders of industry should have an even greater part in our government and that officials elected by the people should have, as their function, merely to see that the great powers of industry are not misused for selfish interests and against the public welfare.

But to do this, he said, we must have more cooperation—much more of it. "The future success of our country as an industrial nation depends on the extent to which cooperation can be developed within the industrial corporation, and between public and corporation."

Eleven years later Mr. Owen D. Young in a public address developed this same thought further, in a most striking manner. Speaking of the need for people in the same line of business to get together and develop standards of practice, Mr. Young said that the growing scope of business makes the old restraints of local reputation quite insufficient. "A man could not sell a spavined horse as sound in his own community without penalty, but he could sell a spavined motor as sound in some other community, perhaps indeed half way 'round the world, without being quickly discovered at home. Even if discovered, the penalty was not so great. The sale of a spavined horse to one of his own community may have been a moral delinquency. The sale of a spavined motor to people quite unknown may have been regarded locally as a clever piece of business."

Mr. Young then continues: "Men of character began to realize that the success of their business depended not alone upon what they did, but, in some measure, what others in the same line of business did. They began to form trade associations. . . . . Gradually through these organizations codes of conduct are being developed, and rules are emerging to enforce standards, both as to character of goods and methods of trading, which are designed to afford proper protection to the members of the organization and for the better service of society."

But this method of self-government has not always been adopted quickly enough. "Too frequently business men have acquiesced, even if they did not participate, in objectionable practices, until an outraged society compelled amateurs to interfere. The amateurs were frequently in the legislature and unwise laws were enacted. . . . It is to be hoped that future business research will not only inspire business men to adopt a standard acceptable to the public conscience, but will also furnish the information on which wise laws may be drafted and wise decisions made."

I suppose you all recognize that yours is one of the most bolshevik of businesses. You may belong to the established church and you may vote the straight ticket at every election but as a group of business men you are the reddest of the red. A Red, as his opponents call him, or a Progressive as he calls himself, is simply a person who believes that the established order is wrong, that there is a better way of doing things, and who wants to try that new way. That is exactly what you believe. You believe that there is a better way of cutting metals than by saws and chisels and a better way of fastening them together than by bolts and rivets. And you have insisted against all sorts of obstacles on trying out your new way—to the great benefit of us all.

But, like all Progressives, you have had to fight against the determined opposition of the Conservatives. The Conservative also has a most important job in this world. He is the fellow who says that the old way is not so bad, and he wants definite and conclusive proof that the new way will actually work, before he accepts it. He is usually decent about it—he is willing to be shown—but he holds doggedly to his job which is to protect our institutions, our lives and our property against untried theories.

In your case, of course, the Conservatives are the insurance companies and the public officials.

These people are definitely responsible for an enormous amount of property and of human life. They insist, quite properly, that before a welded vessel is used under pressure in a place where, in the event of explosion, they would bear the loss of life and property, it must be shown beyond a reasonable doubt that that vessel will be just as strong and just as safe as the other kind of vessel which it replaces. And so you as a group of business men in the acetylene industry are just one regiment in the world-wide eternal battle of Progressive against Conservative, a battle which will last as long as civilization lasts, in which you are always moving forward, sometimes slowly, sometimes faster, but in which each objective gained is only the starting point for a further advance; a battle in which your enemies are really your friends because the world could not get along without either of you.

Now, you pioneers in business, like our forefathers in a pioneer settlement, simply must stick together. That is why this Association is so vitally important to you. The wise leadership of the Association and of your industry has made your battle against the conservative forces a bloodless one, on the whole, where it might have been very bloody. You have the reputation of being one of the most co-operative groups that ever existed, and you have profited greatly thereby because we on the conservative side—we who have a responsibility of one sort or another, for protecting the lives and property of the people—have always felt that the representatives of the acetylene industry were an uncommonly decent and competent lot and (if I may for the moment presume to speak for all the forces of Conservatism) if we have not always agreed entirely with you, our disagreements have been minor and insignificant compared with what they would have been, had your own policies been less candid and generous.

The thousands of industries that make up the National Safety Council, and their elected officers and staff employees, believe thoroughly in America as an industrial nation. We believe that men like Steinmetz and Owen Young are among the major prophets of our day and age. We believe that businesses and business men must cooperate with one another, with their own employees, and with the public. This cooperation takes two concrete forms. The International Acetylene Association is an example of one form—an oganization of, by and for your particular business, upholding your proper interests as against other businesses, and at the same time developing and maintaining standards within your own business. The National Safety Council is an example of the other type of necessary unofficial organization in Twentieth Century America — an organization chiefly of business people, but for a particular object not a particular business—an object which in the long run is identical with the best interests of your business and every business and every individual. It is our firm conviction that through such work as you and we are trying to do, helping without restraining the individual initiative that has made our country what it is, we are contributing to the continued greatness of our nation and the happiness of its people.

January Construction Shows Increase

Total construction contracts awarded during January in the 37 States east of the Rocky Mountains amounted to $427,168,700, according to F. W. Dodge Corporation. These states include about 91 per cent of the total construction volume of the country. This was next to the largest January total on record, and represented an increase of 11 per cent over January of last year. Compared with December, the past month showed a decline of 11 per cent.

Three districts made new high totals for the month of January, the new records being reached by New England, the Central West, and Texas. Three other districts, New York state and northern New Jersey, the southern states, and the Middle Atlantic States, reached totals which were next to the highest ever recorded for January.

The more important items in last month's building and engineering record were: $193,189,200, or 45 per cent of all construction, for residential buildings; $72,038,700, or 17 per cent, for public works and utilities; $68,851,400, or 16 per cent, for commercial buildings; $37,970,300, or 9 per cent, for industrial buildings; $23,369,400, or 5 per cent, for educational buildings; $11,182,400, or 3 per cent, for hospitals and institutions; $9,189,700, or 2 per cent, for social and recreational projects; $5,612,300, or 1 per cent, for public buildings; and $5,532,900, or 1 per cent, for religious and memorial buildings.

Contemplated construction projects were reported for these 37 states to the amount of $904,674,900 during January. This was a 20 per cent increase over the amount reported for January of last year, though it represented a decrease of 9 per cent from the December figure.

Production of Alumina

Alumina is prepared by fusing aluminiferous material with reducing agents such as carbon in the presence of small amounts of sulphides or of substances forming sulphides preferably below 3 per cent. Silicic and titanic acids are first separated by treatment with mineral acids, and the remaining mixture of iron and aluminum salts are then transformed to oxide before treatment as above. The sulphur is introduced as a gas. Sulphur containing combustion gases are used to evaporate and decompose the mixture of iron and aluminum salts. Metallbank u. Metallurgische Ges. A. G. (British Patent 279, 870).

PIT AND QUARRY FOREIGN DIGEST

Hardening of Gypsum Mortars

During the hardening of pure hydraulic gypsum mortars as it may be determined microscopically, a gel is formed and the tiny particles interlace. The mass then becomes shot through with needles, so that finally a hard firmly knit product results. The process may be understood on the assumption that the dihydrate separates from a saturated solution as gel which forms a thin matted coagulum of crystalline dihydrate. The stability towards water is an important factor in the setting of gypsum mortars. The presence of highly basic gypsum compounds may be recognized by their difficult solubility. These compounds are stable at the burning temperature but water effects a hydrolytic cleavage, which is followed by a crystallization, and finally by a gel formation. Both processes take place during the hardening. It is possible to have a mortar which will exhibit a combined hardening, one group in the field of Portland cement and the other in the field of gypsum mortars. The following picture is thus produced: In the final product there will be a mixture of basic calcium sulphate, calcium silicate, and calcium aluminate. By hydration the following result: Monocalcium-hydrosilicate, tricalcium aluminate containing water of crystallization, basic gypsum, crystallized gypsum and some excess lime which separates out as calcium hydroxide. O. F. Honus, (Zement, December 29, 1927).

Progress Necessary in Concrete

The primary object for the new year should be the evolution of methods of preparing concrete, the characteristics of which may be predicted with greater certainty than is now the case. This involves a lessening in the differences observed between the strengths expected and those actually obtained. The charactertistics of concrete must be subjected to closer study. A step forward would be made if the concrete maker possessed more knowledge of the properties of building materials. He must not only have directions as to how an ideal concrete may be made but also examples as to what extent the strength of concrete is dependent upon the amount and kind of cement, upon the effect of the variety of fine and coarse aggregate and the setting water, upon the kind of mixing machine and the time of mixing, upon the desirability of after treatment and so on. More information is very necessary concerning the use of rapid hardening concretes and the proper amounts of their constituents, the permissible loads, etc. For ordinary concrete the permissible loads should be kept lower. Anon, (Tonindustrie Ztg. Jan. 4, 1928).

Curing Concrete

The actions of the chief constituents of Portland cement during the setting and hardening periods are: (a) Tricalcium aluminate and 5:3 calcium aluminate become hydrated during the first 24 hours and cause the setting and hardening during this period. (2) Tricalcium silicate commences to hydrate after the first 24 hours and continues for about 7 days. (c) Dicalcium silicate commences to hydrate after about 7 days and continues almost indefininitely. It is even more important to keep a trowelled face wet than an untrowelled one. It is recommended that concrete be kept wet for at least 14 days. Whenever concrete dries curing almost ceases. It resumes at a diminished rate, when moisture is again available. Early drying is permanently detrimental to concrete. With alternate saturation and drying the curing will be equivalent to a uniformly moist condition if the drying is not too prolonged. The difference in strength between concrete and moist and concrete cured dry is enough to be of great practical importance. Cured concrete has a greater strength dry than wet. Mixes of different richness respond in the same way to different curing methods, but probably not to the same extent. There is no essential difference in manner between the curing of concretes and mortars, but there appears to be quite a difference in degree. The response to an unfavorable environment for a small body of concrete and relatively large surface area is much more rapid and complete. The rate of absorption of water is always rapid until the saturation point is nearly reached. Autogenous healing will take place as long as moisture is present.

J. Singleton-Green (Conc. & Con. Eng. Dec. 1927) and H. J. Gilkey (Proc. am. Conc. Inst. Vol. 22, p. 395).

Surface Treatment of Concrete

The secret of success in obtaining a good face lies in the accurate grading and even mixing of the facing concrete, in placing the concrete in a fairly dry state so that the larger stones do not tend to sink to the bottom, in even tamping in small lifts, and in removing any scum which may rise to the top.

Anon. (Conc. & Con. Eng. December, 1927).

Production of Cement

The raw materials are mixed and placed in small trucks which are passed through a tunnel furnace with regulated heating zones. The mixture is successively dried, causticized, clinkered, cooled and discharged. Soc. des Ciment France, et Bur, d' Organization Economique (French Patent 612,391).

Modern Limestone Kilns

Six essential points listed as important requirements for the best type of rotary grate kilns for burning dolomite apply also to limestone. These are: 1. Uniform distribution of air throughout the kiln after its introduction under the grate. 2. Introduction of this air for combustion under high pressure in order to obtain economically the necessary burning temperature. 3. Complete removal of the burned product by air flotation without fluctuations in pressure, and therefore, without temperature fluctuation either. 4. Uniform working of the rotating pairs of grates over the entire cross section so that no displacement or stoppage of the sintering zone occurs. 5. Prevention of the operation of the rotors (grates) by shearing, which will exert an unfavorable influence upon the grain size of the burned product. 6. Sound and strong construction with no delicate parts, either still or in motion in the kiln. The walls of the kiln are rigid and the interior contains as moving parts only the robustly made cost steel rotors which move like hands of a clock, slowly, in pairs, with opposite movements. Kilns are described in detail, with diagrams. O. Pollert, (Tonindustrie Ztg. Jan. 1, 128).

Cement Guns

Plastic aggregate is projected through a nozzle from a mixing chamber by a pulsating pressure. The mixing chamber is provided with a removable cover, raised and lowered by means of a pressure fluid ram, and adapted to be locked by means of arms operated by a rotatable cam plate mounted on the cover. Rotary arms on a hollow spindle coact with fixed arms on the cylinder to agitate the material, and blades on the spindle are adapted to wipe across the entrance to the aggregate outlet tube producing a pulsating pressure. The material is partly mixed by allowing air pressure to enter through a tube and exhaust through an upper outlet, a baffle being situated at the entrance of the outlet tube to prevent any aggregate from passing. After mixing, pressure air is supplied through an upper opening in the mixer to press the mixture out of the nozzle supply tube. The gear chamber of the mixer is supplied with pressure air to prevent the entrance of the aggregate thereto. H. W. Brown and Bemis Industries, (British Patent 280, 409).

Porous Aggregate

Porous bodies are obtained suitable for use as aggregates for concretes by heating clays and rocks which expand on heating. The crushed material is mixed with fuel and burnt in a current of air. The crushing is of such a nature as to produce pieces of such size and form that their solid volume does not exceed 40 per cent of the volume of the mixture. Eighty per cent of the material should be retained by a sieve having a 2 mm. mesh, but not more than 10 per cent should have a burning depth of more than 15 mm. After crushing, the small particles are rendered plastic by water and clay, if necessary, and molded or drawn into suitable shapes and broken. Fuels may be coke, anthracite or "coal slack." The burnt, porous mass may be crushed and used for concrete aggregate or used to produce building blocks by being burnt in molds.—E. I. Lindman, Stockholm, (British Patent 280, 567).

Gypsum Cements

Hydraulic mortars are formed from dry slaked lime, precipitated gypsum and aluminium silicate. The gypsum used came mainly from plants making hydro fluoric acid, the aluminium silicate from the wastes from the washing of coal. The ratios of the materials $CaSO_4$: $Ca(OH)_2$: SiO_2 : R_2O_3 were as follows 1 : 4.55 : 2.12 : 0.34, also 1 : 2.82 : 1.32 : 0.28 and 1 : 1.62 : 0.76 : 0.16. Mortars with sand in ratios of 1 : 3 were prepared which gave compression strengths up to 625 lbs. per sq. in. after curing. The method of preparing the cements is as follows: 1. The raw materials are first ground in a definite ratio. 2. The ground mixture is then moistened, shaped into molds and dried. 3. The dried molded mixtures are burned at 600 to 850 degrees C. 4. The burned product is ground. Mixed with sand, it forms a mortar. O. F. Honus (Zement, December 22, 1927).

Cement and Plaster Mixtures

Mixtures of cement, cement plaster and gypsum with pigments, sand and other substances are made by grinding the materials together and drawing off the fine particles by air flotation under vacuum. Water proofing agents, such as sodium silicate or hardening agents such as alumina, silica and gypsum can be added during the process. H. E. Doughty, (British Patent 280, 813).

Aluminous Cement and Phosphorus

When phosphorus is prepared by heating together calcium triphosphate (phosphate rock), silica and carbon, a Portland or slag cement ordinarily results as a by-product. But if a portion of the silica is replaced by alumina or clay, a fusible slag is obtained having the composition of an aluminous cement. The vapors evolved consist of phosphorous and carbon monoxide. They are mixed with water vapor and a halogen acid and passed over a carbonaceous material. Beside the cement, the resulting products are phosphoric acid and water glass. E. Urbain, Paris, (British Patent, 280, 763).

INTIMATE NEWS OF MEN AND PLANTS

Stonington Quarry Changes Hands

The Clements Contracting Company has purchased, from the Rogers Granite Corporation, the quarry consisting of 40 acres fronting on Penobscot Bay, Stonington, Maine. This is the quarry from which was taken the pink-gray granite for the County Court House in New York City, the Naval Academy and the addition to Sing Sing prison and had been leased to the George A. Fuller Company which erected the New York Court House. It is announced that the Clements Company will form a corporation for operating the granite quarry.

Slate in 1927

The value of the slate sold at the quarries of the United States in 1927 was $10,873,000, according to estimates furnished by producers to the United States Bureau of Mines, Department of Commerce. This was 12 per cent less than the value reported for 1926. Decrease in demand, especially during the last six months of the year, and lower prices due to keen competition, were general in the slate industry during 1927. Quarries were reported idle, and several firms discontinued business. Consolidation among active firms was also noted.

The roofing slate sold, estimated at 450,000 squares, valued at $4,510,000, decreased 3 per cent in quantity and 11 per cent in value. This represents a decrease of 88 cents in the average value per square.

The total sales of mill stock, estimated at 8,856,000 square feet, valued at $3,508,000, decreased 14 per cent in quantity and 16 per cent in value.

Mill stock for structural slate—2,350,000 square feet, valued at $880,000—decreased 9 per cent in quantity and 11 per cent in value. Electrical slate—1,627,000 square feet, valued at $1,292,000—decreased 12 per cent in quantity and 16 per cent in value.

Mill stock for blackboards and bulletin boards—3,440,000 square feet, valued at $1,070,000—decreased 14 per cent in quantity and 21 per cent in value in 1927. Slate for school slates and for billiard-table tops also showed decrease in both quantity and value. Slate for vaults and covers was the only slate product that showed increased sales in 1927. The output was estimated at 540,000 square feet, valued at $146,000, and represents an increase of 10 per cent in quantity and 12 per cent in value.

The sales of crushed slate for roofing granules and flour in 1927 was estimated at 456,600 short tons, valued at $2,775,000. This represents a decrease of 8 per cent in both quantity and value.

The accompanying table compares the estimated sales of slate by quarrymen in 1927, by uses, with the sales in 1926.

Plaster Wall Is Soundproof

Tests of the United States Bureau of Standards indicate that two inch solid plaster partitions are equivalent, from an acoustical standpoint, to gypsum block, clay, tile or plasterboard partitions. The advantage, if any, is with the solid plaster partition.

New Georgia Plant

The Georgia Lime Rock Company of Perry, Georgia, has acquired about 300 acres in the vicinity of Perry and will build a crushed stone and lime plant. The anticipated capacity will be between 35 and 40 cars per day.

Roofing slate, mill stock*, and slate granules sold in the United States in 1926 and 1927, by uses

	1926		1927 (estimated)	
	Quantity	Value†	Quantity	Value†
Roofing ..... Squares	465,900	$ 5,079,087	450,000	$ 4,510,000
Approximate equivalent in short tons.....	157,450	.....	152,000	.....
Electrical .....square feet	1,857,940	1,537,034	1,627,000	1,292,000
Approximate equivalent in short tons.....	13,350	.....	11,800	.....
Structural and sanitary.....square feet	2,590,340	988,521	2,350,000	880,000
Approximate equivalent in short tons.....	18,550	.....	17,000	.....
Grave vaults and covers.....square feet	490,060	130,882	540,000	146,000
Approximate equivalent in short tons.....	6,900	.....	7,600	.....
Blackboards and bulletin boards.....square feet	3,998,800	1,356,405	3,440,000	1,070,000
Approximate equivalent in short tons.....	10,700	.....	9,200	.....
Billiard-table tops .....square feet	367,220	145,457	299,000	103,000
Approximate equivalent in short tons.....	2,700	.....	2,000	.....
School slates.....pieces	1,820,820	32,886	1,120,000	17,000
Approximate equivalent in square feet.....	973,770	.....	600,000	.....
Approximate equivalent in short tons.....	1,200	.....	800	.....
Granules .....short tons	498,050	3,009,368	456,600	2,775,000
Other.....short tons (estimated)	9,000	73,127	8,000	80,000
	718,000	$12,352,767	665,000	$10,873,000

*In 1926 the mill stock sold, including school slates, was 10,278,130 square feet, valued at $4,191,185; in 1927, 8,856,000 square feet, valued at $3,508,000.
†F. o. b. at point of shipment.

Lien Law Helps

Materialman's Lien Law and Forms, (Northern States Edition), is announced by the Hart Publishing Company of New York. This new book explains the law of materialman's lien in clear concise language. It is arranged under State Chapters with the law of each state digested and explained by a lawyer of the particular state. The authors are practicing lawyers of the various states covered. It gives the local customs and peculiarities of the materialman's lien law of each state.

The Materialman's Lien Law is given in full followed by a digest. Property subject to a lien, time limit for filing lien, place and expense of filing, notices, releases, etc., are explained in detail.

A complete set of legal forms is included for notices to property owners of lien, assignments of lien, cancellation of liens, waiver of liens, affidavits, etc., and given for each state separately after the digest of the lien law. This book will be found useful to all producers, who want to be informed of their lien rights in their own state as well as in the other states in which they do business.

New Sand and Gravel Plant for Iowa

L. G. Everist, Inc., is building a new sand and gravel plant at Hawardson, Iowa. It is announced that by April 1, an all steel modern sand and gravel washing plant will be in operation. The mining will be done by a five ton dragline, loading the unprepared material into seven yard dump cars. The cars will be hauled by a steam locomotive over a standard gauge road and automatically dumped into a hopper. A 24 inch belt conveyor will then carry the material to the crushers, scrubbing pans and screens where it will be sized and segregated into separate bins for shipment.

Thompson Accepts Post

Scott Thompson, recently elected vice-president and manager of the Louisiana Portland Cement Company, became active January 16 according to an announcement by H. Struckman, president. Lewis R. Ferguson, formerly vice-president, has been appointed assistant to the president of the International Cement Corporation of New York of which the Louisiana Company is a subsidiary.

New Gravel Plant Announced For Oakland, California

W. H. Ford, president of the Associated Gravel Company and the Acme Gravel Company has recently announced that a gravel and sand mixing plant will be built at Twenty-sixth and Peralta Streets, Oakland, California. The plant will consist of a group of eight concrete bunkers of the silo type, with automatic elevating machinery, mixing and measuring and all the necessary modern equipment together with warehouses and an office building will be completed as soon as possible. The J. C. Buckbee Company of Chicago, which designed the plant for the Pacific Portland Cement Company, has prepared the plans and specifications for the new operation and the P. J. Walker Company has the construction contract.

Mount Lime Builds New Plant

Information emanating from the office of W. D. Mount, Lynchburg, Virginia is to the effect that the Mount Lime and Chemical Company has been formed with $500,000 capital stock and purchased considerable property eight miles west of Natural Bridge on the Chesapeake and Ohio Railroad. The plant will be of steel construction and will include four gas fired continuous kilns, hydrating plant, chemical laboratory and the most modern equipment and the entire operations will be under the supervision of W. D. Mount.

Neal Gravel Purchases Office Building

The Neal Gravel Company, Mattoon, Illinois, has purchased the Clinic Building and obtained possession, February 1, 1928. The northwest section of the building will be remodeled, to suit, for offices of the company which will occupy its new quarters at an early date.

Clements Purchases Property

The Clements Contracting Company of New York has purchased a 40 acre granite quarry at Stonington, Maine, from the Rogers Sand Corporation and will immediately begin operations.

The property contains a large deposit of valuable pink-grey granite and is partially equipped as it was formerly operated by the George A. Fuller Company.

Crystal Silica Open Plant

The new plant of the Crystal Silica Sand Company was formally opened on February 10th. This plant is located near Oceanside on the Escondido branch of the Santa Fe Railroad in California. The officers of the company include J. A. Benell, president and general manager; O. A. Topham, vice president; T. B. Hatten, treasurer, and C. A. Porter, secretary. These officers and T. V. Allen, D. R. Brown, J. H. Bonnell and W. L. Althome constitute the board of directors.

New Quarry for Oregon

The Miller Construction Company of Klamath Falls, Oregon, has leased a part of the C. L. Holliday dairy ranch and has begun to develop the property. The quarry, when in operation, will be primarily engaged in supplying material for surfacing roads, especially the highway from Klamath Falls to Keno.

Oglesby Granite Quarries Issue Booklet

The Oglesby Granite Quarries of Elberton, Georgia, has issued an illustrated booklet, presenting its monuments, mausoleums and memorials, built of the Blue Oglesby Granite. The channeling method of quarrying is used which results in sound stock and good patterns.

Another Iowa Cement Plant

The Davenport Cement Company is building a $1,500,000 plant on a 300 acre tract of land east of Buffalo, Iowa, which is owned by the company. When completed, the plant will have a capacity of 1500 barrels per days. It will require one year to complete the plant and present plans call for its completion in the spring of 1929.

Rhenquist Purchases Interest In Sand and Gravel

V. N. Rhenquist of Chicago has recently purchased a third interest in the Mount Carmel Sand and Gravel Company of Mount Carmel, Illinois, and will devote his energies entirely to the interests of that concern. Mr. Rhenquist is a brother of A. C. Rhenquist, one of owners, with Henry Serty, senior member of the firm.

New Quarry For Washington

The S. L. Dennis Construction Company of Raymond, Washington, will open a quarry on the "Narrows" of the Willapa River on the west bank above South Bend, Washington. It is planned to install a crusher of about 30 yards' capacity together with other necessary equipment for a modern plant.

Drill Shows Good Stone

Drilling on the Beem Property, between State Road 67 and the railroad near Spencer, Indiana, has located a 20 foot ledge of oolitic limestone, with an average overburden of 15 feet. According to announcements, a modern plant will be installed to develop operations under the management of Ross C. Beem and H. B. Laymen.

New Lime Quarry Opened

Several carloads of machinery have been shipped to the Diamond Springs Lime Company of Folsom, California, for the development of a large quarry in the high grade limestone deposits of El Dorado County. H. P. Brown is president and in charge of operations.

Stone Salesmen Meet

The annual Conference of the Indiana Limestone Salesmen met in Bedford, Indiana, January 27-29 with salesmen from all parts of the nUited States in attendance. Delegates from the Associated General Contractors' Convention at West Baden attended and made an inspection of the quarries and mills in the Bedford vicinity.

Ironton Gravel Company Purchases Plant

The Ironton Gravel Company, Ironton, Ohio, has purchased a hoist, digger, ton boat, gravel hoist, line of barges, electric hoist and other equipment, including the property rights from the Gentil Brothers. To this the Ironton Company has added two tow boats, a fleet of trucks, additional barges and will make extensive additions and improvements as conditions warrant.

Ohio Association Elects Guy C. Baker

Guy C. Baker, vice president of the Greenville Gravel Corporation, Greenville, Ohio, was elected executive secretary of the Ohio Sand and Gravel Dealers Association at the annual convention held in Cleveland. At that election Clifton Houlihan of the Dayton Keystone Sand and Gravel Company was made a director.

Neal Gravel Suffers Loss

The Neal Gravel Company of Mattoon, Illinois, which operates several plants in Illinois and Indiana, sustained considerable loss by a fire at the Summit Grove plant. All the buildings were reported destroyed as a result of the fire which is said to have been caused by defective electric wiring.

New Incorporations

Carbon Shale Products Co., Franklin, Tenn. $5,000. Benton McMillan, H. E. Rodes, J. B. Briggs, J. F. Eggleston, W. A. Johnson.

Mount Lime & Chemical Corp., People's National Bank Bldg., Lynchburg, Va. $500,000. W. D. Mount, Chemical Engr. To produce high grade lime at Natural Bridge Station, Va.

Wisconsin Rock & Fertilizer Co., under the laws of South Dakota, $100,000. Producers of limestone, fertilizer and highway material. Plant at Elmwood, Wis., offices at Milwaukee, Wis., and 507 Tribune Annex Building, Minneapolis, Minn., Fred E. Russell, general manager.

Bainbridge Quarry Co., Cape Girardeau, Mo. $10,000. Logan E. Bean, S. D. True, Louis Mayer.

Enos Sand & Gravel Co., Fort Worth, Tex. $100,000. W. P. Morris, W. S. Willis, D. L. Morris.

Olive Branch Mineral Products Co., Olive Branch, Alexander Co., Ill. $75,000. Charles E. Hinz, Lloyd Cannon, D. I. Kirkham. To mine, grind, wash, refine, and market china clay, silica, flint, and other non-metallic minerals.

Ironton Gravel Co., Ironton, O. $25,000. M. M. McKain, Harry Nicely, G. C. Ross.

Maryland Lime & Cement Co., Inc., 443 S. Central Ave., Baltimore, Md. Charles H. Classen, J. Scott Hunter.

Arkadelphia Gravel Co., Arkadelphia, Ark. $10,000. T. G. Clark, E. W. Huie, Jr., Arkadelphia; J. B. Mason, El Dorado.

Rice Sand & Gravel Co., St. Louis Park, Minn. $50,000. Carl J. Rice, 3136 Second Ave. S., Minneapolis, Minn.

Rock Products Corp., Ft. Worth, Tex. $15,000. A. P. Heddix, S. V. Evans, Austin F. Anderson.

Maribel Gravel Co., Denmark, Wis. 500 shares, $100.00 each. W. W. Bruss, H. A. Bruss, Fred Hansen.

Granite Gravel Co., Ltd., Midland, Ont., Can. $500,000. J. S. McCormick, Windsor, Ont., Can.

Canada Fluorspar Co., Ltd., Toronto, Ont., Can. $40,000.

Standard Lime & Stone Corp., Roscoe, Ill. $20,000. Fred Day. To produce fertilizing lime, crushed rock, washed sand and gravel.

Peninsula Construction Co., Tijuana, Baja, Ca. $20,000. To produce gravel and building sand.

1,655,013. Drag-bucket. John H. Gunnison, Madison, Wis.

1,655,482. System for vibrating industrial screens. Carl S. Weyandt, Pittsburgh, Pa., asignor to National Electric Mfg. Co.

1,655,499. Adjustable plow for centrifugal grinding-mills. William A. Gibson, Allentown, Pa., assignor to Bradley Pulverizer Co., same place.

1,655,523. Apparatus for building composite piles. John W. Taussig, Englewood, N. J., assignor to Raymond Concrete Pile Co., New York, N. Y.

1,655,567. Sand cutting and conveying machine. Elmer A. Rich, Jr., Wilmette, Ill., assignor to American Foundry Equipment Co., New York, N. Y.

1,655,623. Semi-automatic trip for power shovels. George C. Morin, Holyoke, Mass.

1,656,001. Process of proportioning sand and water for concrete. Charles S. Johnson, Champaign, Ill.

1,656,002. Method for proportioning total water in concrete. Charles S. Johnson, Champaign, Ill.

Secures Contract

The Bloomington Limestone Company of Indiana which recently absorbed a number of operating companies and is headed by Harry Johnson, has been given the cut stone contract for the new field house of Indiana University. The contract for the building costing $25,000 has been let to Charles Pike.

Northwestern Gravel Moves

The Northwestern Gravel Company of Des Moines, Iowa, has moved its offices to Lake View and taken quarters in one of its buildings.

Sales of Lime in 1927

The lime sold by producers in the United States in 1927 amounted to 4,337,000 short tons, valued at $38,210,000, according to estimates furnished by lime manufacturers to the United States Bureau of Mines, Department of Commerce. This is a decrease of 5 per cent in quantity and 8 per cent in value as compared with sales in 1926. The sales of hydrated lime, which are included in these figures, amounted to 1,562,000 tons, valued at $14,300,000, a decrease of 3 per cent in quantity and 6 per cent in value. The average unit value of all lime showed a decrease from $9.11 a ton in 1926 to $8.81 in 1927, and that of hydrated lime a decrease from $9.45 a ton in 1926 to $9.15 in 1927.

Conditions in the lime industry during 1927 were reported as unsettled and unsatisfactory, especially for the last six months of the year. Demand for building, chemical, and agricultural lime was irregular, and although in general it was reported as less or the same as in 1926, there were many reports of good or increased demand.

Ohio, the leading State, showed a decrease of 7 per cent in total quantity of sales and 8 per cent in sales of hydrated lime. Pennsylvania, which ranked second, showed a decrease of 2 per cent in total sales. Of the 23 States in which more than 25,000 tons were sold, only 8 showed increased sales.

Sales of lime for building in 1927 are estimated at 2,200,000 tons; for chemical uses, 1,847,000 tons; and for agriculture, 290,000 tons.

Sales of deadburned dolomite for refractory use were estimated at 370,000 tons, valued at $3,316,000, a decrease of 4 per cent in quantity.

The accompanying table compares the estimated sales of lime by the producers in 1927, by States, with the sales in 1926.

Lime sold by the producers in the United States in 1926 and 1927

State	1926 Hydrated lime (Short tons)	1926 Total lime (Short tons)	1926 Total lime Value	1927 (estimated) Hydrated lime (Short tons)	1927 (estimated) Total lime (Short tons)	1927 (estimated) Total lime Value
Ohio	752,764	1,056,589	$10,348,880	690,000	978,000	$9,445,000
Pennsylvania	237,066	794,196	6,303,312	258,000	780,000	5,800,000
Missouri	83,451	263,467	2,218,943	91,000	274,000	2,295,000
West Virginia	42,164	267,464	1,719,590	36,000	250,000	1,576,000
Alabama	29,791	226,732	1,721,558	26,000	208,000	1,589,000
Wisconsin	15,458	216,414	1,896,772	14,000	196,000	1,680,000
Massachusetts	19,005	202,065	2,653,746	20,400	181,000	2,322,000
Tennessee	52,190	173,363	1,319,303	50,000	176,000	1,261,000
Virginia	62,191	188,696	1,453,095	63,000	172,000	1,250,000
Illinois	26,549	103,180	1,013,740	32,000	117,000	1,130,000
Maine	(a)	128,120	1,615,776	22,000	116,000	1,364,000
Indiana	46,332	126,005	970,624	45,000	107,000	778,000
Michigan	15,468	107,671	995,123	17,000	100,000	942,000
New York	36,193	107,326	1,016,647	36,000	97,000	923,000
Texas	33,443	78,293	706,153	34,000	79,000	709,000
California	9,294	67,421	800,089	(a)	65,000	774,000
Maryland	36,624	63,639	524,242	28,000	58,000	421,000
Vermont	9,731	56,378	677,944	9,600	57,000	557,000
Connecticut	(a)	61,742	695,495	(a)	53,000	602,000
Arizona	(a)	42,757	421,549	(a)	47,000	455,000
Arkansas	(a)	31,346	275,935	(a)	35,000	322,000
Minnesota	(a)	28,522	296,068	(a)	(a)	(a)
Washington	(a)	23,783	298,014	(a)	27,000	320,000
Undistributed	99,097	151,229	1,623,854	90,000	164,000	1,695,000
	1,606,811	4,560,398	41,566,452	1,562,000	4,337,000	38,210,000

(a) Included under "Undistributed."

Automobile Statistics for 1927

Output	
Total output	3,532,000
Cars	3,065,000
Trucks	467,000
Closed cars	2,453,000
Percentage of closed cars	80
Cars' wholesale value	$2,191,000,000
Trucks' wholesale value	$ 366,950,000
Total value	$2,557,950,000
Tire output	65,000,000
Wholesale value of tires for replacements	$ 592,000,000
Wholesale value of parts and accessories for replacements	$ 750,000,000
Cars' average retail price	$ 950
Trucks' average retail price	$ 1,050
Persons employed in motor vehicle and allied lines	3,670,000
Motor vehicle taxes	$ 728,000,000
Registration	
United States motor vehicles registered	23,000,000
World registration	29,000,000
Farm motor vehicle registration	4,800,000
Auto Financing	
Per cent new cars sold on time	58
Average note at time of purchase, new cars	$ 575
Average note at time of purchase, used cars	$ 285
Relation to Other Business	
Carloads of automotive freight shipped in 1927	3,159,000
Of rubber imported, automobiles industry uses	84%
Plate glass used by automobile industry	50%
Copper used by automobile industry	12%
Iron and steel used by automobile industry	14%
Gallons of gasoline consumed by motor vehicles	9,698,000,000
Gallons of motor oil consumed	390,000,000
Pounds of crude rubber used tires	625,000,000
Pounds of cotton used in tires	220,000,000
Busses and Trucks	
Busses being used	90,000
Motor busses built	11,500
Consolidated schools using motor transportation	14,400
Street railways using motor busses	370
Busses used by street railways	8,600
Busses used by steam railroads	1,175
Steam railroads using motor busses	60
Exports	
Number of motor vehicles exported (United States and Canada)	542,000
Value of motor vehicles and parts exported. (Including engines and tires) U. S. and Canada	$ 508,000,000
Per cent increase in motor vehicle exports over 1926	12%
Per cent of motor vehicle exported	15%

First Aid Training Offered to Wisconsin Producers

Arrangements have been made by the Industrial Commission of Wisconsin whereby first-aid will be given by the U. S. Bureau of Mines in ten Wisconsin cities. The course of training is offered to quarrymen, gravel pit men, highway workers and contractors.

The schedule of meetings to still be held, which will be on Tuesday in each instance, at 1:15 P. M., is as follows:

Milwaukee—Feb. 21, Civil Service Rooms, City Hall.

Sheboygan—Feb. 28, Court House.

Manitowoc—Mar. 6, Court House.

Green Bay—Mar. 13, Court House.

Wausau—Mar. 20, City Hall.

Red Granite—Mar. 27, Town Hall.

All of the above clases will start at noon at 1:30 o'clock on the date indicated above and continues for 2½ days. This is the regular course given by the U. S. Bureau of Mines and a certificate is issued to those taking training.

The entire course is divided as follows: (1) Stopping arterial bleeding; (2) Bandaging; (3) Splinting of fractures; (4) Artificial respiration; (5) Transportation of wounded. These subjects are taken up in their order and it is therefore necessary for all to report at the beginning of the course.

Employers are advised to have represented at these schools two men from each operation so that one may act as an alternate of the other in his absence.

First aid training not only provides for the emergency treatment of accidental injuries but if well done, contributes in a large measure to their prevention. A man brought face to face with a clear picture of eventualities of accidents is certain to do the best he can to prevent accidental injury to himself and to others around him.

These schools have in past years received cordial support from employers and approximately 2000 men have received the full course of training. Numerous cases have been cited during the past two years where lives have been saved and serious injuries alleviated by expert handling and care on the part of those men receiving this training. With compensation experience rating in effect the reduction in lost time due to accidents is important.

School for Sculptors

A trade school for teaching stone cutting, carving and commercial sculpturing is to be opened in the building of the Heltonville Limestone Company, Heltonville, Indiana, under the direction of C. D. Denato. Practical carving and stone cutting will be taught daily in the mill at Heltonville and theoretical classes will be conducted two evenings each week.

Indiana Buys Quarries

The State of Indiana recently purchased 20 acres of limestone land from C. L. Saltzgaver, of Croton, in Lee County. The land is underlaid with a ledge of high grade limestone which tested 98 per cent for agricultural use and is valuable as a crushed stone supply for highways. The State also has leased land west of Farmington, aVn Buren County, to produce crushed stone for the construction of hard surfaced roads.

More State Plant Talk

At a session of the Governor's Council, January 25th, Governor Young of California requested Alexander Heron, State Director of Finance, and B. B. Meek, Director of Public Works, to devise ways and means for overcoming the high prices charged for cement being used in the construction of highways and other state works. The Governor called attention to the legislation proposed by Senator J. M. Inman which would have provided for a State plant. Heron denounced the "cement trust" and stated that the last bids received by the State Purchasing Division for supplying the State Harbor Commission with cement were all for the same figure, $2.11 per barrel. He pointed out that contractors are bidding on highway work with a basis of 18 cents per barrel higher on cement than the State pays.

Ohio Association Elects Secretary-Editor

The Ohio Stone Crushers Association, at its annual meeting, elected Claude Clark secretary of the Association and editor of its magazine to succeed A. P. Sandles.

NEWS OF EQUIPMENT MANUFACTURERS

Largest Shovel in the World

A 15-cubic yard electric power shovel, the largest shovel in the world as to dipper capacity, physical size, output and power, is to be built for the United Electric Coal Company of Danville, Illinois. This shovel, to be used in open pit coal mining, will be built by the Marion Steam Shovel Company and operated entirely by General Electric motors. It will probably be put into service May 1, 1928.

The shovel boom will be 120 and the dipper stick 82 feet long. Thus it will be able to lift material to a height of from 90 to 100 feet. All the shovel operations will be controlled by one man, who will govern the workings by means of three hand levers and one foot pedal. The control will be of the variable voltage type, by means of which the generator voltage is varied by varying the generator field.

The total weight of the shovel will be approximately 1,350 tons and will be mounted on four crawling, self-propelled traction trucks. With the shovels now in use, material can be dug out from beneath a maximum of 40 feet of overburden, while the new shovel will strip coal from under 60 feet. The cost of operation is expected to be considerably reduced because of the high rate of output with the same labor expense.

Power will come to the shovel through a trailing cable approximately three inches in diameter, wound on a cable reel attached to the rear of the shovel and of sufficient length to allow the shovel to operate at a maximum distance of 1,000 feet from the point of power supply. The electric supply to the shovel will be alternating current at 4,000 volts. This will drive a 5 unit General Electric motor generator set, consisting of a motor, three generators and an exciter. The motor for driving the other four units is a 1700 h.p., 4,000 volt, 720 r.p.m. machine. One 860 k.w. generator will supply direct current up to 800 volts for operating the hoist motors; two 350 k.w. generators will supply direct current up to 1,000 volts for operating the swing and crowd motors, and a 50 k.w. exciter will supply 125 volts, direct current, to excite the fields of the motors and generators. The total weight of the motor generator set will be approximately 130,000 pounds. It will be built with a self-supporting, three-point suspension base, 24½ square yards.

The hoisting motion of the shovel will be provided by two 450 h.p., variable-voltage, heavy duty, steel mill type motors, operating at speeds up to a maximum of 500 r.p.m. Two 150 h.p., variable voltage motors of the same type, with a maximum rated speed of 1,000 r.p.m., will provide the swing motion. A motor with a rating of 100 foot-pounds torque will operate the dipper trip, and two 3 h.p., squirrel-cage, induction motors will operate oil pumps. Power for driving the latter motors will be supplied by small auxiliary transformers.

An Improved Shovel Crane

The American Hoist and Derrick Company is distributing an illustrated bulletin describing the "American Gopher" shovel crane, and showing its application to the work of shovel, crane, and dragline. It is said to be an all steel machine with low-upkeep cost, built to the high standards which have made the name synoymous with sound design, suitable materials and life service.

The machine has fewer parts with less danger of delay for repairs; heavy duty shafts are heat treated, nickel chrome steel; castings are carbon or alloy steel, annealed; the gears are nickel chrome or high carbon steel; SKF ball bearings are used where practical; parts are interchangeable where possible; high pressure lubrication is used exclusively; crawler treads are made of cast chrome steel; and the unit has fewer parts than is usual in a machine of this character.

The machine is mounted on continuous chain treads, 21 inches wide, cast of chrome steel, with flat bottoms for travelling over pavement. The tread sprockets are driven by heavy alloy steel roller chains. The high carbon steel bronze bushed end sprockets are of the self-cleaning type. The machine will travel at the rate of 1½ miles per hour in high gear and ⅝ of a mile in low gear.

The shovel-crane is assembled to be driven with a four cylinder gasoline Waukesha motor, model "JL", which develops 80 h.p. at 850 r.p.m or a four cylinder, 6 by 6½ Fairbanks Morse Diesel engine which develops up to 80 h.p. at 800 r.p.m.

The shovel boom is of heavy structural steel and the powerful rope crowd is of rugged and simple construction. The twin dipper sticks which straddle the boom are made of welded structural steel. The roller path is a high carbon steel casting accurately machined to the taper of the rollers. The gear teeth are formed on the inner side of the roller path, and the rollers are of high carbon steel.

The shovel-crane will handle 24,000 pounds at 12 foot radius and 5,000 pounds at 40 feet. It is 11 feet, 4 inches high and 10 feet wide with a tail swing of 10 feet and works successfully in close quarters. As a dragline, it will handle 10,000 pounds at 175 feet per minute on a 21 inch drum or 16,000 pounds at 100 feet a minute on a 12 inch drum.

New Electric Hoist Added By American Engineering

"A New Member of a Famous Family" is the title of an illustrated bulletin being distributed by the American Engineering Company which deals with the "A-E-Co" stationary electric hoist. The machine is rated at 80 per cent mechanical efficiency and may be used for lifting or pulling as a stationary unit and is easily made portable by mounting on skids. Ballbearing fully enclosed, standard squirrel cage a.c. motors are used, either 110, 220, 440 or 550 volts, 60 cycle and 2 or 3 phase.

American Carbolite Company Marketing Carbic Output

Effective on January 9 the American Carbolite Company, Inc., began to merchandise the entire output of Carbic Manufacturing Company. American Carbolite Company, Inc., has appointed Oxweld Acetylene Company its exclusive agent for the sale of Carbic lighting, welding and cutting equipment, and Union Carbide Sales Company its exclusive agent for the sale of Carbic cakes.

New Mundy Agents

The Mundy Sales Corporation announces the following new agents: Herman M. Brown Company, Des Moines, Iowa; G. F. Lowe Company, Chicago, Illinois; Star Machinery Company, Seattle, Washington, and Geo. Mueller Equipment Company, Milwaukee, Wisconsin.

Botfield Appoints Prosser

Botfield Refractories Company, manufacturers of Adamant Fire Brick Cement, announces the appointment of Mr. Ires Prosser as Southeastern representative. Mr. Prossers' territory will embrace the entire Southeast from North Carolina to San Antonio, Texas. His headquarters will be Atlanta, Georgia.

Thirty Locomotives for Russia

Officials of the Geo. D. Whitcomb Company have just announced the securing of a foreign order for locomotives that is probably one of the largest orders placed for industrial locomotives since Uncle Sam ceased wartime buying. The order covers thirty locomotives for the Russian Imperial Railways Commission.

The Russian authorities were represented by the Amtorg Trading Corporation of New York City, who have been placing heavy orders lately for construction machinery and materials for use in Russia. During 1927, the Amtorg firm placed orders on behalf of Russia totalling $27,000,000, and the construction program that is to be carried out in 1928 calls for a greatly increased expenditure.

The locomotives purchased from the Whitcomb Company are to be used in building 1,000 miles of new railway from a junction with the present trans-Siberian railway, south through Turkestan to a point near Afghanistan. This district has immense stores of natural resources that have never been exploited for lack of transportation facilities, and the new line will open up this rich territory.

The region to be traversed is primitive and wild, inhabited only by nomadic tribes. In carrying out the work, the construction forces will be compelled to transport much of their material by trucks and mule trains. The equipment and supplies for the entire job are being carefully selected, in view of the fact that the work is to be carried out several thousand miles from the source of supplies.

The locomotives are all of the internal combustion type, powered with heavy duty Climax engines. They will be fitted to burn kerosene and will develop 122 horsepower at a speed of 1,000 revolutions per minute. The order includes twenty twelve-ton and ten eighteen-ton locomotives.

New Vibrating Screen

Marked by simplicity of construction, and requiring, it is asserted, a minimum upkeep expense, and possessing adaptability to almost any fine screening condition, a new ball bearing vibrating screen was announced recently by Link Belt Company.

This screen is a mechanically operated device, reduced to the simplest possible mechanism, viz., one moving part which rotates in large, oversize ball bearings.

The vibrator has no cams, springs, striking blocks or levers to adjust or renew. It simply consists of a shaft, driven at suitable speed from any common source of power. This shaft, thrown out of balance by adjustable counterweights, imparts vibrations to the screen box on which it is mounted, and these in turn, are transmitted to the screen cloth secured, under tension, in the box.

There are five standard sizes, viz.: 2 by 5 feet, 3 by 5 feet, 4 by 5 feet, 3 by 8 feet, and 4 by 8 feet, and each can be furnished with either one or two screening surfaces, giving a wide application for materials of varying size and capacities.

Binders are provided on the fine mesh cloths, for protection against tearing. Two flanged clamp plates engage these binders or the bent edges of the cloth; and by tightening the wing nuts on each side, the cloth can be quickly stretched to the desired tension.

These side clamps serve the fourfold purpose of stretching the screen cloth, clamping the cloth to its deck, eliminating wear of screen box side frames, and preventing leakage along side edges. A longitudinal vibrator strip assists the screening action by imparting raps to the cloth, minimizing wear and binding.

Binders are quickly detachable and can be re-used; and screen cloths, which are of standard width, can be obtained in rolls from the cloth manufacturers.

A feed hopper attached to the receiving end of screen box, vibrates with it, controls the feed, and uniformly spreads the material over the screening surface.

For screening materials containing small particles, the vibrating feed hopper is fitted with a counterweighted swinging feed gate. This combination makes it easy to receive a non-uniform feed, and spreads the material over the width of screen cloth at just the right speed—moreover adding about 2 feet to the effective length of our screen, and obviating the use of mechanical distributors.

New Screw Conveyor Book

As the aggregate of more than 50 years experience in the manufacture of screw conveyors, H. W. Caldwell & Son Company has just issued an 85-page book devoted entirely to screw conveyor, fittings and accessories.

A glimpse into the history of screw conveying shows that at the time the Caldwell Company was founded—in 1874—screw conveyors were largely built on the job with wooden shafts and various forms of flights.

Mr. Caldwell invented the flight made from a circular disc so that a complete turn around the shaft was made with one flight, which was quite an improvement over the best to be had at that time. He also standardized conveyors on pipe shafts with removable couplings, which standards have been continued to the present time with slight changes.

These original improvements and inventions were followed later by the invention of the Caldwell helicoid conveyor.

Their new book covers both the Caldwell helicoid and sectional flight types. The data, in addition to being very complete, has been arranged in a manner to offer the utmost convenience to those interested in the subject.

Automatic Weighing Device Described in Detail

Merrick Scale Manufacturing Company is distributing bulletin 1127 describing the Addoweight totalizing dial scale and illustrating its different uses and the advantages of weighing without a weighmaster. It not only indicates the individual weights, but registers on a continuous counter the total of all the weights and the total number of any weights taken. Addoweight may be used where a platform or dial scale is required; it may be adapted to overhead track systems, industrial railways and gravity roller conveyors, for weighing packages, bags, tubs, luggies, cars, wheelbarrows or almost any commodity under usual conditions.

C. B. Manville Passes

Charles B. Manville, founder of the Johns-Manville Corporation and its allied companies died recently of apoplexy at his home in Peasantville, New York. The great pioneer in the asbestos field had spent 93 years, most of it in developing his industries, valued at a huge fortune.

Mekeel Joins Nugent

Van Cortright Mekeel, formerly connected with Taylor-Wharton Iron and Steel Company, in capacities of Special Research Investigator, Mechanical Engineer and Sales Engineer, has resigned to accept a post as Special Representative of The Nugent Steel Castings Company.

Thew Appoints

Leeds, Tozzer & Company, Inc., 75 West Street, New York City, has been appointed special sales representative for the Thew Shovel Company of Lorain, Ohio, and the Universal Crane Company of Elyria, Ohio, for the Eastern Railways of the United States.

New G. E. Data

Several new General Electric bulletins in loose leaf form for inclusion in the catalog have been issued, among which is GEA-823 which describes and illustrates Atomic hydrogen arc welding equipment for hand welding on 60-cycle units. With this method an alternating current is maintained between adjustable tungten wire electrodes and hydrogen gas is fed to the arc around the electrodes. By this means, welds can be made on thin metals or on metals and alloys generally considered unweldable.

GEA-841 is a description of the CR7006-D26 magnetic switch which consists of a triple pole, barrier type magnetically operated contactor with normally open interlock and two hand reset temperature overload relays mounted on a moulded base and enclosed in a steel drawn shell enclosing case. It is suitable for throwing small a.c. motors directly across the line.

GEA-880 describes the CR4409 protective panels for overload and undervoltage protection for d.c. crane motors which are suitable for protecting motors controlled by drum, magnetic or similiar types of controllers and are designed for mounting in the crane cab where they are accessible to the operator.

GEA-61A treats on constant speed direct current type CD motors 3 to 200 h.p.; 4 and 6 poles; 40 degrees Centigrade; 115, 230 or 550 volts, shunt or compound wound. The principal features are, practically perfect commutation; simple, strong self insulating brush yoke; reaction type brush holder; steel shell hard tin babbitted bearing linings; and carefully proportion stabilized windings.

GEA-858 supersedes 60011B on low speed direct current generators type LDR, form A, 2 wire and form O, 3 wire, designed for direct connection to steam or internal combustion engines. These generators were designed to insure strength without excessive weight, excellent sure strength without excessive weight, excellent ventilation and successful operation to meet the demand for low speed generators suitable for direct connection to steam or internal combustion engines.

GEA-529A describes low speed synchronous motors types TS and QS, "6000 Series," large sizes with welded steel plate frames for direct connection to reciprocating compressors. Standard ratings range from 20 h.p. to 700 h.p. at speeds between 72 and 440 r.p.m. They are of simple and compact construction so that they occupy little space, are easy to install and require practically no attendance to keep them in operation.

GEA-732A is a description of D. & W. oil fuse cutouts type D. Among the important advances are, standardization of heavy duty steel construction; increased dielectric strength; increased interrupting capacity ratings which have been proved at the testing station; and increased safety of operation, attained through encasing the fuse links in herkolite solution.

GEA-8754 supersedes GEA-425 and describes Type WD-30 A arc welder for belt, motor or gas engine drive; and is self excited, constant energy and single operator. It may be advantageously utilized in any repair shop or industrial plant using iron or steel and is suited to either production or repair work.

Modern Blasting in Detail

Among the publications received is "Modern Blasting in Quarries and Open Pits," by J. Barab, with an introduction by T. W. Bacchus, 168 pages, illustrated, bound with pyroxylin coated fabric; Hercules Powder Company, Wilmington, Delaware, publisher.

The volume is illustrated by photographs of the practical applications of explosives to industry and diagrams portraying the results of scientific investigations and laboratory experiments of an interesting and practical nature.

The book contains chapters on the history of the development of high explosives; the reactions of different explosives under varied conditions; the various classes of explosives at present being used in quarries and open pits and their properties; blasting accessories and their uses with considerable information on the arrangement of the holes and making contacts; drills and drilling which includes the care of different types of drills and modern methods of sharpening; blasting methods, including a scientific and practical discussion of the different plans and combinations in present use and a special chapter on blasting by the tunnel method by J. C. Cushing and H. Peterson with a special chapter on hercoblasting. Lime stone quarries here and there treats of the methods used advantageously in the different districts; blasting for trap rock ballast and gravel gives the prevalent methods in the districts discussed; shale, sand and silica quarries are treated at length in which chapter gravel pits are included; quarrying for cement and flux stone are treated in a comprehensive manner; technical records and records on quarry blasts explain the methods for knowing each item of cost and its relation to the total cost; an element of cost is accidents and the book shows how to reduce costs through accident prevention and how to increase production and lower the production costs.

In addition, there are chapters on open pit coal, iron and copper mining and a complete treatise on the construction and maintenance of magazines for storing explosives.

Climax Exhibits

The exhibit of the Climax Engineering Company at the Cleveland Road Show was in the Arena—Space Number AA-37. Past policies were varied by showing complete units ready for the dealer to sell and contractor to use instead of its complete line of bare engines for installation in industrial machinery.

The largest exhibit was an 85 h.p. engine especially adapted for sand pump drive, radiator cooled with a Perfex radiator, complete with vacuum feed, service pump drive and electric starter and generator, mounted on a complete structural steel base and the power transmitted through a Twin Disc heavy duty enclosed clutch to a special Allis Chalmers Texrope drive. This furnishes the drive and the necessary speed reduction between the engine and a Hetherington and Berner 6 inch sand pump. Sand pump itself is a heavy duty pump made of semi-steel and capable of passing 4 inch rocks through it. The entire unit, operated together has a capacity of 1000 gallons per minute or 30 cubic yards of solids, and is a mighty popular size for contractors to mount on barrel type dredges for sand and gravel work.

Another unit was the Climax Model "KU", four cylinder 5 by 6½ inch engine complete with carburetor, magneto, vacuum tank, and mounted on cast iron sub-base and connected by flexible coupling to a Dayton-Dowd 6 inch water pump capable of delivering 1200 gallons per minute against a 75 foot head. The exhibit also included one of the Climax Company's TU, 4 cylinder, 5½ by 7 inch complete portable power units mounted on wheels for easy portability to the job, to be used as power for rock crushers, saw mills and temporary belt connection to pumps and generators.

Each of these engines have a new feature in the form of an automatic spark advance, which entirely takes control of the spark from the hands of the operator, as no spark connection can be made. Spark is in the correct position at time of cranking the engine, and in correct position regardless of load or speed.

H. M. Davison Resigns

H. M. Davison, who has been with the Hayward Company for a number of years, during the past seven of which he has been general manager of sales, has resigned.

Kennedy Van Saun Moves

Kennedy Van Saun Manufacturing and Engineering Corporation are now located in their new and larger quarters in the No. 2 Park Avenue Building (between 32nd and 33rd streets), New York City.

D. A. Cheyette Joins Traylor

D. A. Cheyette has entered the employ of the Traylor Engineering and Manufacturing Company in the New York office as assistant to District Manager R. R. Shafter.

Recent Patents

The following patents of interest to readers of this journal recently were issued from the United States Patent Office. Copies thereof may be obtained from R. E. Burnham, patent and trademark attorney, Continental Trust Building, Washington, D. C., at the rate of 20c each. State number of patent and name of inventor when ordering.

1,656,176. Drive mechanism for grizzlies. Gordon F. Dodge, New York, N. Y., assignor to Robins Conveying Belt Co., Passaic, N. J.

1,656,895. Conical crushing mill. Hugo Ackermann, Godesburg-on-the-Rhine, and Wilhelm Langenheim, Bonn-on-the-Rhine, Germany.

1,656,903. Concrete making. John G. Ahlers, New York, N. Y.

1,656,904. Concrete-strength regulator. John G. Ahlers, New York, N. Y.

1,656,984. Cementitious composition. Jesse A. McCormick, Franklin Park, Va., and Charles A. Cabell, Washington, D. C., assignors to National Lime Association, Washington, D. C.

1,657,566. Art of making concrete lumber and other cementitious articles. Florence S. Crozier, New York, N. Y.

1,657,646. Recleaning sieve. Severin N. Sorensen, St. Paul, Minn.

1,657,762. Apparatus for handling mixing, and pouring concrete. Hugh P. Paris, Seattle, Wash., assignor to Paris Transit Mixer Co., same place.

1,657,763. Safety drive means for transit concrete-mixers. Hugh P. Paris, Seattle, Wash., assignor to Paris Transit Mixer Co., same place.

1,657,764. Transit-concrete-mixer drive. Hugh P. Paris, Seattle, Wash., assignor to Paris Transit Mixer Co., same place.

1,657,926. Clam-shell bucket. Edward L. Harrington, Erie, Pa., assignor to G. H. Williams Co., same place.

1,658,046. Pneumatic concrete conveying and placing. James H. Fitzgerald, Westfield, N. J., assignor to Ransome Concrete Machinery Co., Dunellen, N. J.

1,658,443. Cement-kiln system. Davis S. Jacobus, Jersey City, N. J., assignor to Babcock & Wilcox Co., Bayonne, N. J.

1,658,717. Excavating-machine. Alfred T. Hansen, Green Bay, Wis.

Westinghouse Promotes

Announcement of five promotions among the executive staff of the manufacturing department of the Westinghouse Electric and Manufacturing Company has been made by H. P. Davis, vice president. W. J. Longmore has been transferred from the office of General Purchasing Agent to Consulting Supervisor of Purchases; E. R. Norris, from Director of Works Equipment to General Works Manager of all Manufacturing Operations; A. W. Bass, from Director of Works Records and Statistics to Assistant to the Vice President; S. E. Marks, from Director of Traffic and Shipping to Director of Traffic; and C. G. Taylor from Director of Purchases to General Purchasing Agent.

New Separator Pulley Book

"Magnetic Protection" is the title of a new book just published by The Cutler-Hammer Mfg. Co., Milwaukee, Wisconsin, giving complete information on Magnetic Separator Pulleys. The book explains in detail the construction and design of all types of separator pulleys. There are several helpful tables giving the cubic feet per hour capacity of all separator pulleys sizes, and the correct width and thickness of the belts to be used.

The book is decidedly interesting in that it explains in detail the construction features which Cutler-Hammer maintains are absolutely necessary if unfailing, complete protection and continuous operation are to be assured.

Best Block Expands

Alfred W. Scherer, president of the Best Block Company, Milwaukee, Wisconsin, has announced that the plant will be expanded to increase production from the present 7,000 to 10,000 blocks per day and more than double the storage capacity. The capital stock has been increased from $40,000 to $230,000, of which about $80,000 will be expended in the expansion program.

Georgia Portland Holds Annual Meeting

The annual meeting of the Georgia Portland Cement Corporation stockholders was held in the offices of the Company, 1500 Southern Finance Corporation Building, Augusta, Georgia, January 31st, at which time officers were elected and plans were formulated for the ensuing year. J. L. Hankinson was elected president; J. C. Hagler, vice-president; C. J. Morgan, treasurer; H. W. Neil, secretary; and Mrs. J. L. Harrison, assistant secretary-treasurer.

Plans of the corporation, which is capitalized at $2,500,000, embrace the building of the first cement producing unit of the Corporation at Sandersville, Georgia, and an additional plant subsequently at Augusta, it was announced.

Minnesota Stone Travels

John H. Smith, secretary of the Minnesota Stone Quarries Association, has announced that Minnesota stone is to be used in three major projects in California, Chicago and Minneapolis. The Chamber of Commerce Association of Minneapolis has selected Mankato Gray Ledge Stone for the exterior cut stone portion of its new structure to be supplied by Fowler and Pay and the T. R. Coughlon Stone Company.

The University of California, southern branch at Los Angeles will use Kesota Limestone in the construction of the library building, auditorium and class room building. The Biesanz Stone Company of Winona has been awarded the contract for the cut stone to be used in the exterior of the Kenneth Apartment Building in Chicago.

Lehigh Cement Plant Resumes

Plant number 3, at New Castle, Pennsylvania, of the Lehigh Portland Cement Company, resumed operations January 28th. Necessary repairs and improvement of the plant is said to have been the cause of the shutdown.

Tijuana to Develop Sand and Gravel Property

The Peninsula Corporation of Tijuana has been incorporated to develop the easily accessible caliche gravel and building sand deposits 11 miles southeast of Tijuana to make the importation of this class of material from the United States unnecessary. Steam shovels will be used in the excavation and all crushing, sizing and washing equipment will be placed in operation as soon as possible.

THE AUTOMOTIVE FULL DIESEL ENGINE

By R. J. Broege

Chief Engineer, The Buda Company*

The popular demand for Diesel engines is primarily due to their economical operation and the lesser fire risk than that accompanying gasoline operations.

In presenting this paper, no effort is made to compare the different makes of Diesel engines nor any Diesel engine still in the experimental or development stages, but is particularly confined to an Industrial Automotive full Diesel engine developed in 1923 and sold in Germany to the commercial trade, proven out in actual service under private and individual ownership.

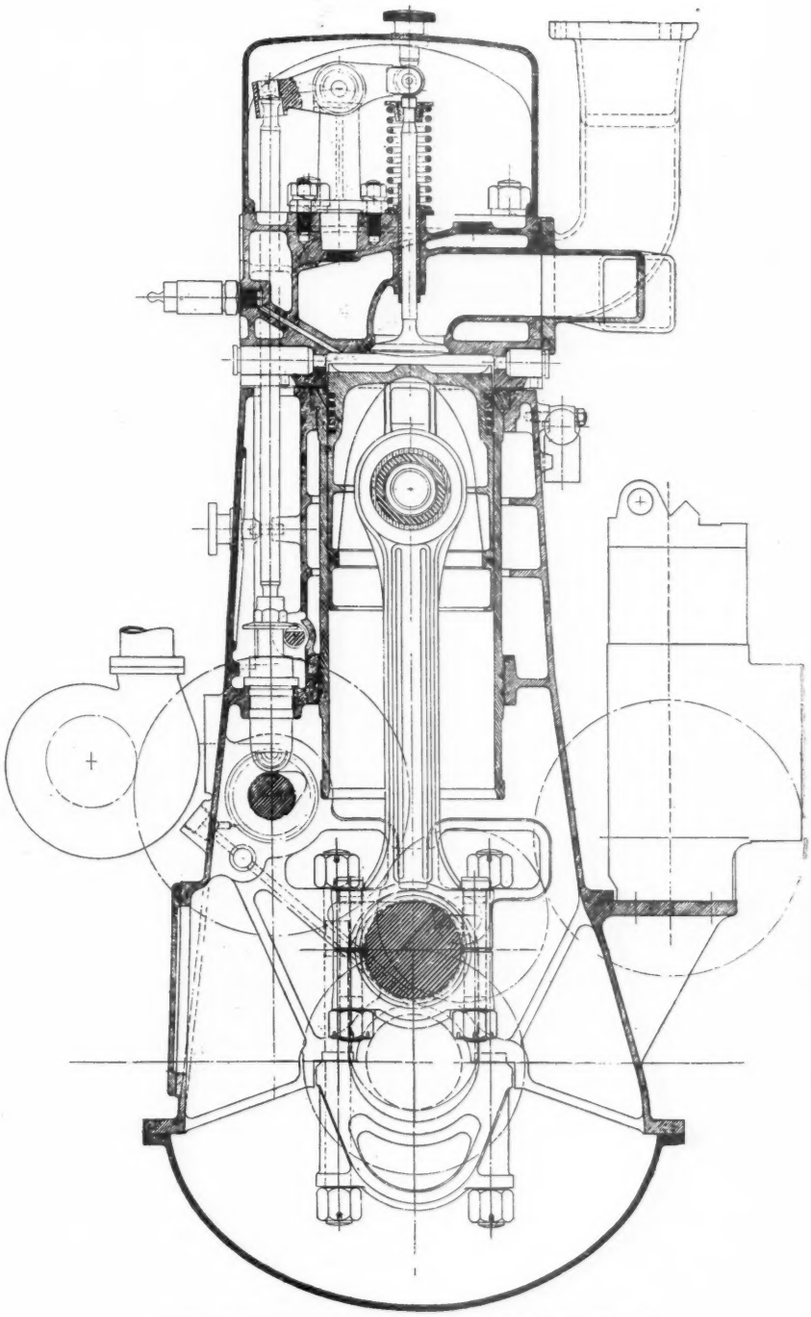
Since the above date, this engine has been applied to shovels, cranes, hoists, locomotives, rail cars, generator sets, trucks, marine service, etc., etc.

The American built Diesel, with which this paper particularly deals, is built under a license and to the patents of the Maschinenfabrik-Augsburg-Nuernburg, Germany, M. A. N. To give you an idea of the development leading up to this engine, it may not be out of place to mention that Mr. Diesel developed the original Diesel engine in the shops of the M. A. N. and was with them until his demise.

The commonly known Diesel engines with air compressors are built from one cylinder to various multi-cylinder types. From the earliest to the latest, the engines range from 20 h.p. to 15,000 h.p. per engine. They are considered complicated, very heavy, and expensive to build, weighing as high as 75 to 300 pounds per h.p. The larger engines are very slow speed, around 70 to 100 r.p.m., and the smaller size har lly ever exceed a speed of 300 to 450 r.p.m.

For many years, it was thought impossible to build these engines simpler and lighter. However, the demand for light and higher speed Diesel engines for submarine service opened the way. The advancement in the Diesel sub-marine engine indicated greater possibilities in other lines. Consequently, an industrial automotive compressorless solid injection full Diesel engine of the 4-stroke cycle was developed.

These industrial automotive compressorless solid injection Diesel engines should, in no way, be compared with the commonly know slow speed heavy Diesels of either the air injection or solid injection types.

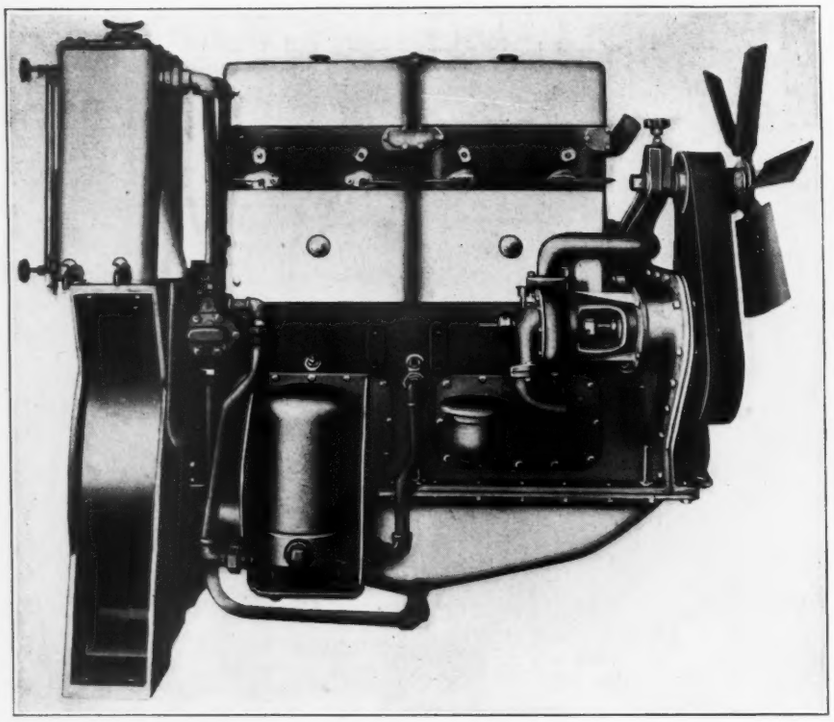


Cross Section Drawing of the Buda M. A. N. Diesel

Right here I believe it is fair to state that the industrial automotive high speed Diesel is here and has already gone through many of the stages that the present day gasoline engine has gone through before coming to the present highly developed state. This type of industrial automotive Diesel engine will perform economically over a wide range of service, such as in commercial motor trucks or in excavator machinery equally as well as gasoline engines with cheaper fuel and far better fuel economy with less fire risk. It will perform equally as well as in any other service that the gasoline industrial automotive engine is used for.

One of these Diesel truck engines has been in service for several months in a truck owned by The Buda Company and has been put in service parallel with their gasoline trucks.

*Abstracted from a paper presented before the Annual Meeting of the Society of Automotive Engineers, January 24th to 27th, 1928.



The Buda M. A. N. Diesel Engine

This engine is 50 h.p. and weighs 1100 pounds. It was installed in a well known 4-ton truck chassis made in this country without any alteration being required in the hood length or radiator.

The Diesel engine was installed in a similar chassis without any view of experimental development and fully for practical purposes to see how gasoline truck drivers would comment upon it and how it would handle in traffic such as in Chicago.

Learning to operate this Diesel truck required no more effort or time than to learn to operate a gasoline truck. In addition to the greater economy, the driver soon discovered that the Diesel engine had far better lugging abilities than was the case with the gasoline truck.

Contrary to general belief, the cooling of this Diesel engine was far easier than the 4½x6 inches 4-cylinder gasoline engine. The same radiator was used as for the gasoline engine and during the warm summer months, the water never heated sufficiently to raise the temperature so that the red would come up to the average running mark in the motometer. As soon as cool weather started, it was found necessary to provide the radiator with a shutter in order to keep the engine up to temperature for good operation.

The illustrations show the American built industrial automotive compressorless solid injection full Diesel engine manufactured by The Buda Company, Harvey, Illinois, having 5 inch bore by 8 inch stroke, of 4 cycle operation. This view is of the fuel pump side and shows the fuel filter; fuel dividers; and inlet and exhaust manifolds with the elbow for air filter application.

In the design and construction of the American built engine, no attempt was made to deviate from principles involved in the M. A. N. design. The only purpose was to make their already highly developed engine more adaptable to American standards and practices and to simplify where possible to aid service and production.

The crank case and cylinder housing are of boxed construction cast integral en bloc for any number of cylinders. This produces a rigid and light design, making a very smooth operating engine. The cylinder proper consist of grey iron inserted sleeve which is readily renewable without any difficulty. The main babbit lined bearings are suspended in the crank case and secured by inserted bolts, there being a bearing between every cylinder.

The oil pan is aluminum for lightness so that it can be easily dropped for bearing adjustment as in most industrial automotive type gasoline engines. Provision has also been made for removing the pistons and rods from the bottom. However, they may also be removed through the top if desired. Hand holes are provided on the side of the crank case for connecting rod bearing adjustment.

The crank shaft along with the flywheel are balanced statically and dynamically. The flywheel is arranged with a steel starting gear and enclosed in a flywheel housing; the flywheel housing being the smallest practical because of the necessity of the large flywheel to produce energy for starting up well as steady operation.

Electric starters or a 2 cylinder air cooled double opposed gasoline engine may be used for starting purposes, both being arranged with a gear drive automatically engaging the ring gear on the flywheel. To aid the initial turning over of the engine, a manually controlled compression release has been provided. After the engine is spinning, compression may be engaged on one cylinder until it fires, after which all cylinders may be engaged.

The valves are located in the head and are operated by rocker arms and roller push rods. The valve tappet adjustments can be conveniently made by removing the cylinder head cover which leaves the rocker arms in plain view without any accessories or other parts in the way.

The valve in the head design is desirable for obtaining the desired compression space for the most efficient pressures. The inlet valve has an integral deflector on the head which, with the angular direction of the fuel spray, produces the necessary turbulence for complete mixture of air and fuel necessary to reduce clean combustion.

The cylinder heads are cut in pairs for lightness to facilitate easy removal, and are protected by a safety valve.

The air inlet pipe has a pre-heater attached to aid in starting under extremely cold conditions and is arranged for the application of an air filter. The exhaust pipe is large and has an outlet flange suitable for attaching a muffler.

All parts are completely enclosed but are readily accessible by removing the hand hole plates, push rod covers, or cylinder head covers, the latter two being held by one hand nut each.

The cooling is accomplished by the conventional water pump of centrifugal type driven off the gear train. Provision is made for the generator drive off the extended water pump shaft.

Force feed lubrication to all moving parts is a feature. This is done by a dual geared pump operating a dry sump system. Oil is taken from the supply tank mounted on the flywheel housing from where the pressure pump forces it through the filter to the main and cam shaft bearings. From the main bearings, it goes to the crank pins and up the drilled connecting rods to the wrist pins. It is also forced to the rocker arm as-

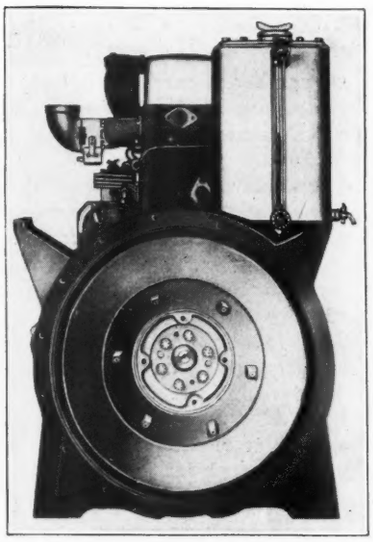
sembly and to the fuel pump. The timing gears are lubricated by a jet of oil directed to each pair at the point where the gears mesh. The oil from the main bearings and all other moving parts drains to the bottom of the sump pan from which the sump pump returns it through a screen to the supply tank. Mechanical lubrication of the pistons has also been provided for if desired. The constant oil pressure is maintained and protected by safety valves. All oil passes through screens before entering the pumps and then the filter before it reaches the moving parts. The dry sump system helps to accomplish this and also enabled the engine to be operated at any reasonable angle without leakage or starving any bearing surface.

Careful consideration has been given to accessibility of all working parts for ease of inspection and servicing. The integral crank case and cylinder housing with walls between cylinders from top to bottom gives a very rigid construction and permits the use of much thinner sections which does a great deal to decrease the weight of the engine.

The fuel pump is mounted on a bracket integral with the crank case and is positive, driven off the timing gear train. It is a cam actuated plunger type with a plunger and a cut-off valve for each engine cylinder. The cut-off valve and plunger are actuated by fulcrum tappets interposed between the main drive cams and the plunger and cut-off valve. The cut-off valve can be easily adjusted in the same manner as adjusting ordinary valve tappets. All moving parts are enclosed in a common housing and operated by one drive shaft having drive cams integral.

The engine speed is actually controlled by the governor built into the fuel pump and operating the controlling valves (cut-off valves). These valves may also be manually controlled if desired. The speed of the engine is increased or decreased by the point of the fuel cut-off and duration of injection, depending upon the plunger and valve position in relation to piston position and speed. The two controls are the only ones for operating the engine and correspond very closely to the spark and gas controls of the gasoline engine. The fuel injection advance lever location can be readily determined and located for a wide range of speed and the engine then controlled by the fuel cut-off lever the same as is accomplished by the carburetor control lever on gasoline engines.

Contrary to popular belief acquired from the older types of stationary Diesels, this engine is very simple to operate and requires no longer period for training operators than with gasoline engines.



End View of Buda M. A. N. Diesel

The nozzles are of the open and solid injection type having one single opening and are all interchangeable. They are as easily removed and cleaned as spark plugs and they do not require cleaning any oftener than spark plugs for the fuel is very carefully filtered through special filters of fine metallic gauze before entering the fuel pump from which it passes through to the injection nozzles. The fine gauze is of such mesh that any foreign matter which can pass through same will also pass through the nozzles thereby eliminating the possibilities of nozzles clogging.

In addition to the light weight; small space required; and simplicity as compared with the conventional air compressor injection Diesel engines, there are many other points of merit when comparing with other types of engines:

1. Compared with gasoline engine: drawing from the largest supply of cheaper and non-inflammable hydro-carbon fuels; lower consumption per h.p., especially so under variable load conditions; automatic ignition eliminating accessories and drives such as are required for magnetos or distributers, resulting in greater relability; simplifying and eliminating possible difficulties which might arise from additional and complicated equipment.

2. Compared with fuel oil vaporizing engines: elimination of auxiliary fuels for starting; always ready for starting; improved adaptabilities for automotive purposes; no contamination of lubricating oil by fuel oil.

3. Compared with ignition chamber type engines: simpler cylinder head construction, especially starting; elimination of the possibility of requiring auxiliary fuel for starting; eliminates the ignition cartridge or electric ignition coils with their necessary batteries; better adaptability to the commercial industrial, automotive and marine trade; or any other place the gasoline engine is used; more uniform operation with cold engine or no-load even at low speeds.

4. Compared with hot bulb engines; lower fuel consumption, especially under heavier loads; less weight; elimination of bulb lamp for heating up hot bulb; always ready for starting; longer life cylinder head.

In summing up, it can readily be seen that simplicity in addition to the greater economy of operation, at the same time resulting in a high degree of reliability; with small wear and tear, indicate that industrial automotive Diesel engines are possible, even compared with the present heavy duty types of gasoline engines, weight and space required being about equal. The S.A.M. standard can be applied to practically the same degree. There seems to be no reason why this engine can not be applied in many instances in the industrial automotive field and benefit by the economy and conserve the supply of gasoline and at the same time reduce fire risk.

Morse Silent Chain Drives Feature New Handbook

The Morse Chain Company has recently issued a handbook on silent chain drives that treats very thoroughly the subject of silent chain power transmission and greatly facilitates the selection and design of the proper drive for any given requirements.

Complete instructions on how to design silent chain drives are given together with a discussion of the various factors that must be considered. This is followed by an example of an actual design.

The new Morse speed reducer with Morse flexible coupling, enclosed in cast iron housing, is also completely illustrated and described. In fact, this book is a complete and ready reference for solving most any power transmission problem.

Also, there are tables giving sprocket diameters, sprocket list prices, chain list prices, standard hub lengths, bores and other data that is useful in the successful design of chain drives. Complete instructions are given as to the installation, care and operation of Morse drives.

Another section of the book is devoted entirely to the illustration and description of Morse drives on various types of machinery and in almost every industry.

Twenty-five Years of Service

This year marks the twenty-fifth anniversary of the Equipment Corporation of America. This company enjoys an eminent position in the field of used equipment, which has come about largely through the far sighted business methods of the personnel of the company under the able

H. M. Capron

guidance of H. M. Capron as president.

Mr. Capron was born in Kenosha, Wisconsin, but he has always lived in Chicago. On leaving school he began his business career in the survey department of a fire insurance company, but he soon entered into the construction field particularly through the building supply field and the manufacture of concrete products machinery.

He organized an association of concrete mixer manufacturers which later became a bureau of the Associated General Contractors. During the World War Mr. Capron effected the organization necessary to collect and distribute the construction machinery required in building cantonments, shipyards, etc.

Under the direction of Mr. Capron the service features of the Equipment Corporation have become a distinguished part of the company itself. The staff of experienced engineers is maintained to assist in the layout and choice of equipment necessary to a particular job. Warehouses and repair shops have been established at strategic points throughout the country. These plants and shops are thoroughly equipped to put used machinery in a satisfactory recondition to be sold under a guarantee. This scope and service of the Equipment Corporation of America is in its twenty-fifth year of business rendering a complete nationwide service of tremendous importance to the Pit and

New Power Plow Scraper Built by Garst

On another page of this issue is the first announcement of the new power scraper manufactured by the Garst Manufacturing Company. This is an old product with a new name with a few changes in design. It is really a power drag scraper, but due to the plow-like design, it was decided by the manufacturers to substitute the word plow for drag.

Goodwin Garst, owner of the Garst Manufacturing Company, became associated with L. P. Green in a sand and gravel property over two years ago, and from this association became interested in the development of the drag scraper business. Mr. Garst now owns six basic patents on scrapers that were formerly owned by Mr. Green. Associated with Mr. Garst is William K. Robbins formerly general superintendent of the A. M. Castle Company, who has also had a wide knowledge of the construction of scrapers during a period of seven years.

This Garst scraper is very carefully designed and tested, and the principles are the same as those that have been in use for years. The plow shaped design can be said to be the result of years of development. Although the old scrapers use the plow like design, the plowshare was never developed. With the development of the removable plowshare the use of the scraper will be widened into new fields due to the fact that the former designs could not be used in soils of a firm and hard texture. The plowshare, being removable, may be changed to various shapes so as to fit it for the kind of soil in which it is to be used.

The company has on hand a stock in all sizes sufficient to meet a normal demand for immediate shipment and will probably carry small stock with their dealers in different sections of the country. Full details of the construction of the scraper and its uses are discussed in a special bulletin.

New Westinghouse Catalog

The 1928-1930 catalog of Electrical Supplies of the Westinghouse Electric and Manufacturing Company has just been announced. This 1200-page catalog presents the electrical and mechanical features and application information for all supply apparatus and appliances manufactured by the company, and in addition a representative list of large motor and generating apparatus.

Important among new developments is a complete line of network protectors, transformers, regulators, and relays designed for low voltage alternating-current distribution networks. In the field of instruments and relays there are more than fifty new or improved designs. Among measuring instruments are remote indicating meters and relays, a single-phase portable standard watthour meter, portable radio meters, portable multi-element oscillographs, railroad tachometers, and special meters for marine installations. A triplex instrument for measuring current in all three phases of a line, vest pocket ammeter, a ratio-differential relay, the line of OB watthour meters and other contributions to the electrical industry are described.

Among traction apparatus there are various designs of trolley frogs and clamps, adjustable spreaders, catenary pull-offs, catenary steady strains, dead-end clamps, messenger clinch sleeve, arc-weld flexible bonds, arcon rail bonds, and flameweld signal bonds. Other equipment includes airport floodlighting equipment, farm lighting, portable arc-welders, and small turbine-generator sets.

Buffalo Truck Scales

The Buffalo Scale Company, Incorporated, is distributing illustrated literature describing the Buffalo Motor Truck Scales of the A. R. E. A. bridge and shallow pit types. The three most important considerations for the purchaser of scales, as stated, are accuracy, strength and endurance. Without accuracy, the scale is worthless, relentlessly robbing either the buyer or the seller; if the scale lacks strength, it cannot survive the strain of service; and the necessity for endurance, to weigh, year after year without breakdown or adjustment is readily apparent.

Many states have passed laws, limiting the wheel load of trucks. New York state has a load limit of 11,200 pounds and the size, arrangement and spacing of the girders and platform timber have been so thoroughly worked out for the shallow pit scales that any point on the scale platform will stand a wheel load of 11,200 pounds.

The motor truck scale uses the Buffalo suspension, which because of its simplicity and minimized friction, factors largely in the smooth accurate operation of the scale. The scale is free from needless adjustments as there are no unnecessary parts to complicate installation, operation or to detract from its accuracy.

Because these scales are built free from friction as far as possible, they are giving a high degree of satisfaction. Through simplification these scales have acquired this low ratio of friction and an increased accuracy and durability.